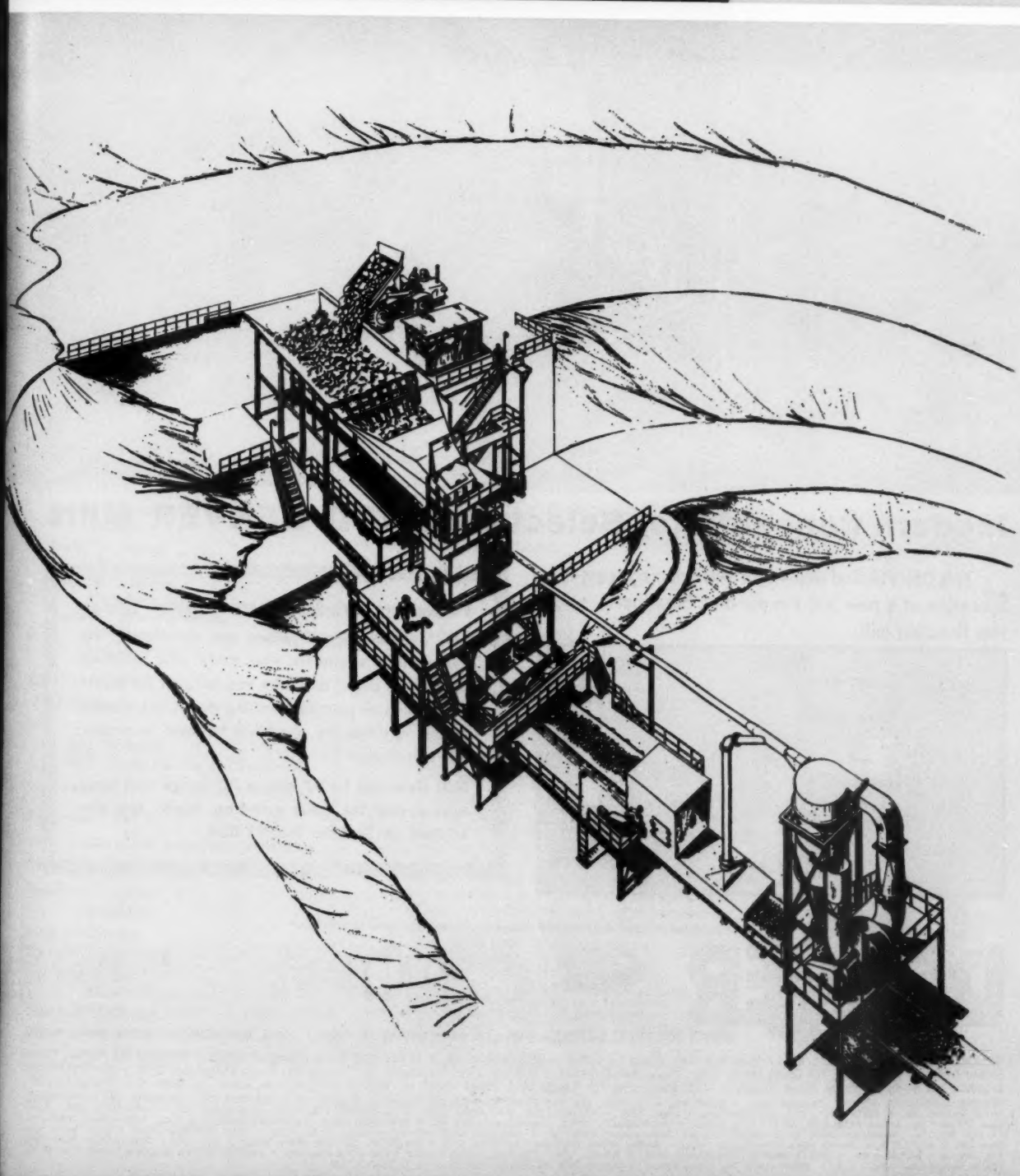
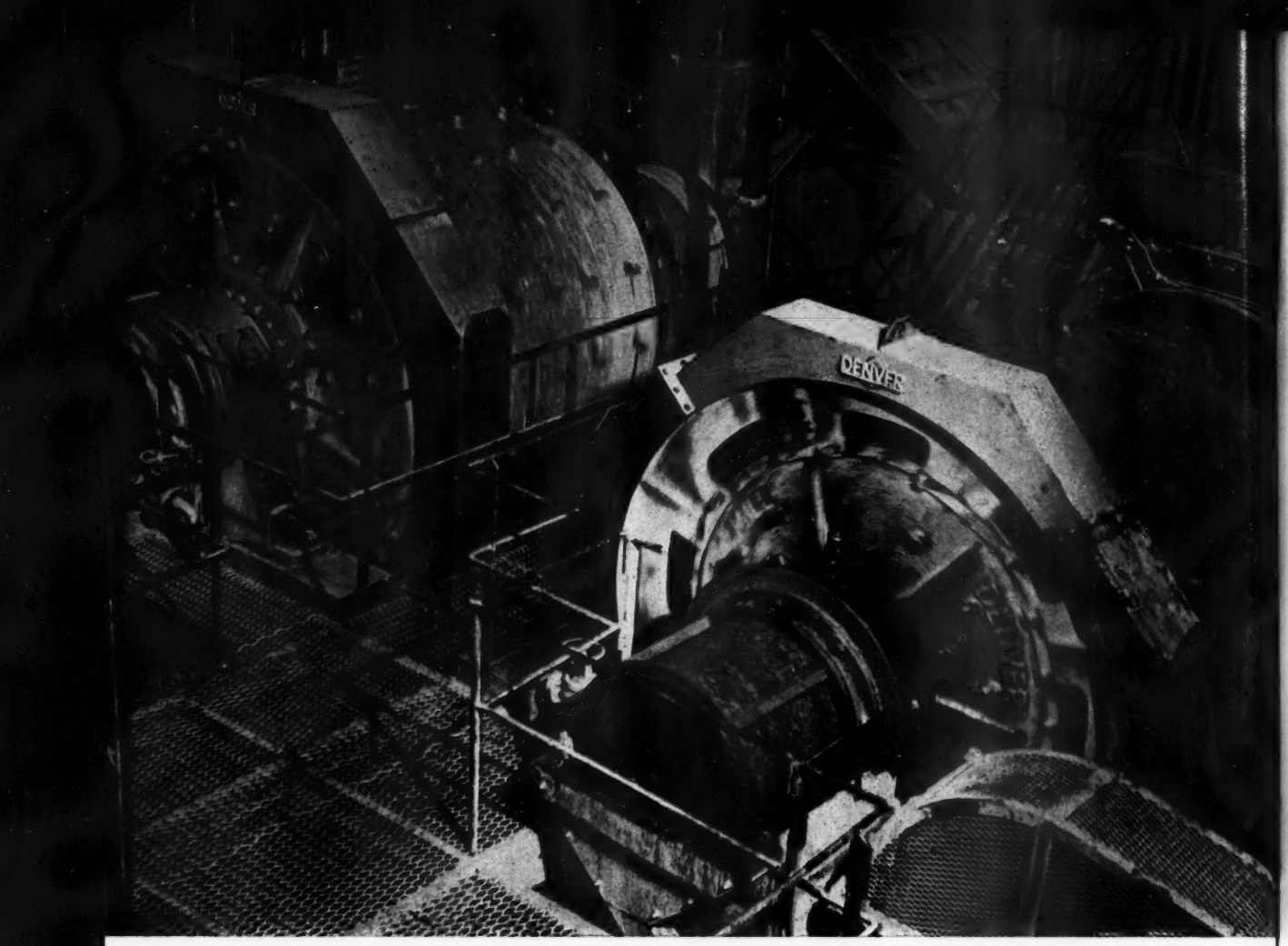
MINING CONGRESS JOURNAL

JULY 1961





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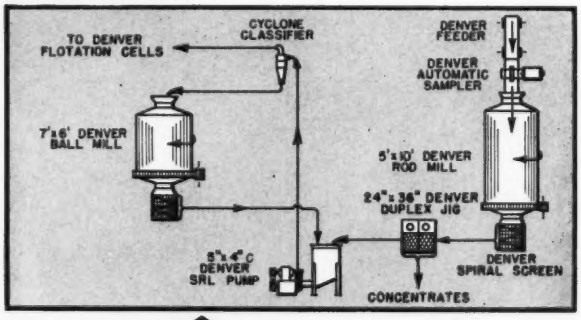
This DENVER Rod Mill—Ball Mill grinding team is in operation at a new 500 ton-per-day, base metal, selective flotation mill.



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MINING CONGRESS JOURNAL

VOL. 47 JULY 1961 NO. 7

CONTENTS

Opinions expressed by the authors within these pages are their own and do not necessarily represent those of the American Mining Congress.

ARTICLES

SPECIAL SECTION

DEPARTMENTS

ON OUR COVER

Perspective view of the crusher area at the Boron, Calif., open pit mine of U. S. Borax & Chemical Corp. Prepared by John Dana, engineering draftsman. The article beginning at page 48 of this issue, "Economics of Truck Vs. Belt Haulage," relates similarities in experience at Boron and at the Crestmore, Calif., underground mine of Riverside Cement Co. in selecting belt systems for elevating ore to their processing plants.

Published Monthly. Yearly subscriptions, United States, Canada, Central and South America, $3.00. Foreign, $10.00. Single copies, $0.75. February Annual Review Issue, $1.25. Second class postage paid at Washington, D. C., and at additional Post Office, Lancaster, Pennsylvania.

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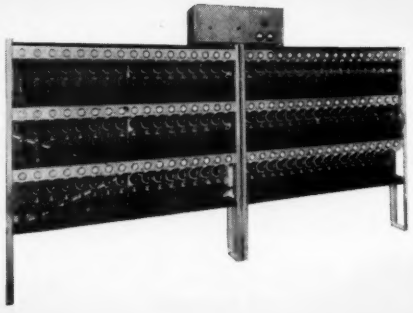

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featured IN THIS ISSUE—and the AUTHORS

THE REALITIES OF FREE ENTERPRISE

In 1930 the Federal Government, or its agencies, provided less than one percent of the total electricity consumed in the U. S. Today 14 percent of the country's electric capacity is operated by the Government. This growth of public power is dangerous because it stems from Government which has nothing to give except that which it has first taken away. The author advocates that the nation's industrialists dedicate themselves to reversing the trend toward all-enveloping Government.

E. M. Naughton, president and general manager of Utah Power & Light Co. since 1954, has been associated with the electric industry for 35 years. He was with Texas Power & Light Co. before joining Utah Power & Light in 1935 as superintendent of steam-electric generating plants. Widely known in industry, he is a director of Edison Electric Institute and the National Association of Electric Companies.

PLANNING FOR EFFICIENT CLEANING PLANT OPERATION

Every possible effort was expended in designing U. S. Steel's Maple Creek preparation plant to eliminate potential operating "bugs." As a result—the plant has operated efficiently from the first day it was "put on the line." The author outlines the considerations that went into planning this modern facility, and the reasons for selecting the equipment installed.

James B. Girod, assistant general superintendent, Frick District-Coal Division, U. S. Steel Corp., has devoted most of his career to this company. Starting as an underground laborer in September 1949, he rose through the ranks, becoming assistant mine superintendent in 1953 and mine superintendent in 1957. He has held his present position since February 1958.

PRACTICAL USE OF ROCK MECHANICS

Ground behavior around a mine opening depends to a great extent upon whether the ground consists of fractured or unfractured rock. In solid rock an opening is supported in the manner of a beam spanning a room; in fractured rock an arch develops to support the opening. Methods for strengthening and using natural ground structures are discussed along with measures for relieving stress at stope faces and pillars, and thereby reduce the number of rock bursts.

Seth D. Woodruff is a civil engineer in the Department of Public Works, City of Los Angeles, where he has been employed for the past eight years principally on design and construction of sewers and storm drains. Before joining the City of Los Angeles, he was senior mining engineer for Day Mines, Inc. Woodruff holds a Professional Engineer of Mines degree and is a registered Civil Engineer in California.

PREDICTING PERFORMANCE OF CONTINUOUS MINER OPERATORS

The AMC Mechanical Mining Committee has been investigating various factors which may possibly be used in predicting the performance of continuous miner operators. Coordination, mechanical comprehension, age, height, weight, dependents and experience were some of the characteristics considered. The results are interesting, significant, and provocative. This is the first step in a continuing study and future reports will be made as results are available.

This Coal Division progress report was prepared by the Personnel Subcommittee of the Mechanical Mining Committee, American Mining Congress. Members are Myles Altimus, U. S. Steel Corp.; Harold Durrett, Hanna Coal Co.; and John Osmanski, Island Creek Coal Co., chairman.

(CONTINUED ON PAGE 5)

HUGHES *Shaft Cutters*

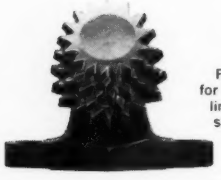
put the "bite" in big bits

Type **S**

Formerly type SCS
for soft formations
(Calcite, shale, clay)

Type **M**

Formerly type SCM
for medium rock (Limestone,
sandstone, sandy shales)

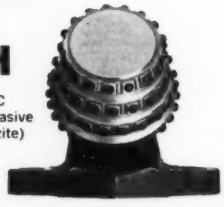


Type **H**

Formerly type SCH
for hard rock (Siliceous
limestone, dolomite,
sandstone, granite)

Type **HH**

Formerly type RSC
for extremely hard abrasive
rock (Taconite, quartzite)



Shown above is a 44-inch bit which gets its bite from cone type cutters developed and manufactured by Hughes Tool Company. Bits equipped with Hughes cutters are now being used to successfully sink shafts from 2½ feet to 7½ feet in diameter — to depths of several hundred feet. Shafts up to 15 feet in diameter have been drilled on an experimental basis.

Where the rotary method of sinking shafts has been used, results have proved this method of drilling significantly more efficient and economical. Drilling costs are lower, the hole is uniform and clean, and time required is far less than for conventional methods.

Hughes manufactures a complete line of cone-type replaceable cutters, each specifically designed for a particular range of formations. The superior performance built into each Hughes shaft cutter is a direct result of Hughes' more than 50 years of specialized rotary drilling experience.

For more information about the rotary method of drilling large diameter holes, contact your Hughes representative, or Hughes Industrial Products, Hughes Tool Company, Houston, Texas.

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MANUFACTURERS OF "ROTA-BLAST" ROCK BITS FOR BLAST HOLE DRILLING

(CONTINUED FROM PAGE 3)

IN THIS ISSUE—and the AUTHORS

ECONOMICS OF TRUCK VS. BELT HAULAGE

Similar haulage problems exist at the open pit mine of U. S. Borax & Chemical Corp. and the Crestmore underground mine of Riverside Cement Co. Experience and planning are also closely parallel, each company having a sizeable ore body located well below the processing plant elevation. Both used off-highway trucks to open their deposits, and planned belt conveyors, fed by trucks, to lift ore to the surface.

MAINTENANCE OF CONTINUOUS MINING EQUIPMENT

Zeigler No. 4 mine of Bell & Zoller Coal Co. is averaging 76 tons of clean coal per face man-shift on pillaring sections. This outstanding performance is the result of continually applying engineering principles in a program designed to help management do its job more effectively. Of special interest are the changes made by the company on its continuous mining machines, the reasons for the changes, and how they affected performance.

NEW DEVELOPMENTS IN INITIATION OF BLASTS IN MINING

Valid or not, complaints about noise, vibration and air blast created by open pit blasting are of real concern to mining companies. The explosives industry has developed a low energy detonating cord, commonly known as LEDC, which substantially reduces the noise level normally associated with open pit blasting. A single electric blasting cap is needed to initiate a typical shot, and does not have to be connected until the shot is ready for firing—which means that over-all safety is improved.

DEVELOPMENTS IN AUTOGENOUS GRINDING

At four concentrators with a combined capacity of over 15,000 tpd, ball mills were converted to autogenous mills in 1959. These concentrators are in the Elliott Lake area of Ontario, and employ some of the largest grinding units in Canada. Interest in the use of screened ore as grinding media has been particularly high in Canada, where, in addition to numerous conversions, several new autogenous mills have been installed in recent years. Also mentioned are recent installations in Sweden and South Africa.

HORIZONTAL AIR DRILLING

The question of horizontal versus vertical blasthole drilling has been revived by the development of horizontal, rotary air drills. These large capacity, high production units are of necessity large and heavy, but they are fast and will penetrate rock. This report describes the equipment and the conditions applicable to its use, and discusses the performance of a 150-ton horizontal rotary unit in service at Peabody's Power mine in Missouri.

AUTHORS

D. M. Cooper's earlier experience was in the coal fields of Utah. For the past ten years he has been with U. S. Borax & Chemical Corp.

D. M. Cooper

P. B. Nalle

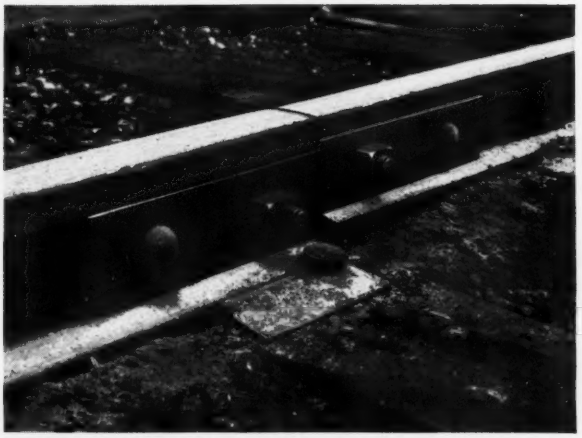
at Boron, Calif., where he is now senior mining engineer. Peter B. Nalle was employed for three years by St. Joseph Lead Co. before joining Riverside Cement Co. in 1951. Since 1958, he has been superintendent of mining.

Arthur Towles, maintenance engineer, Bell & Zoller Coal Co., was supervisor in charge of maintenance at the Murdock mine until he was transferred to the company's central shops at Johnston City, Ill., and placed in charge of all of the firm's mines in Illinois and Kentucky. Before joining Bell & Zoller, he was employed by Mid-Continent Coal Corp. and Mid-West Utilities Co. in the development of the Green Diamond and Bradbury mines.

Harlan J. Poel was technical service manager of the Explosives Department, E. I. duPont de Nemours & Co. He died at the age of 46 on April 6 in Wilmington, Del. He joined duPont in 1941 and subsequently served as sales representative, technical service representative, export sales manager, and for 16 years as technical service manager of the Explosives Department.

Bunting S. Crocker joined Kilborn Engineering Ltd. in 1953 as chief metallurgist and director, and since 1958 has been vice president. He has had extensive milling experience, including 19 years with Lake Shore Mines at Kirkland Lake, Ontario, where he served as mill superintendent and chief metallurgist, and in mill research. His special interests are grinding, leaching, flotation, roasting and mill design.

N. O. Lewis is primarily a mechanical or equipment man. However, he has worked for a number of years in close coordination with Davis Robbins, president of Robbins Machine & Manufacturing Co., who has devoted a lifetime to coal mining. At present Lewis is a director of the company and chief engineer.



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BETHLEHEM GUARD RAIL, DESIGN 745, is one-piece type for use with wood ties. No loose parts such as clamps, bolts, braces are required. Furnished complete with foot-guards, ready for installation.

BETHLEHEM HOOK-TWIN FROG PLATES grip rail base tightly, distribute track motion over tie, remove direct pull from spikes which anchor the plate. Used in pairs, easily adapted to any frog position or angle.

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Have your Euclid dealer give you detailed information and show you how these big "Eucs" can cut your hauling costs. Euclid Division of General Motors, Hudson, Ohio

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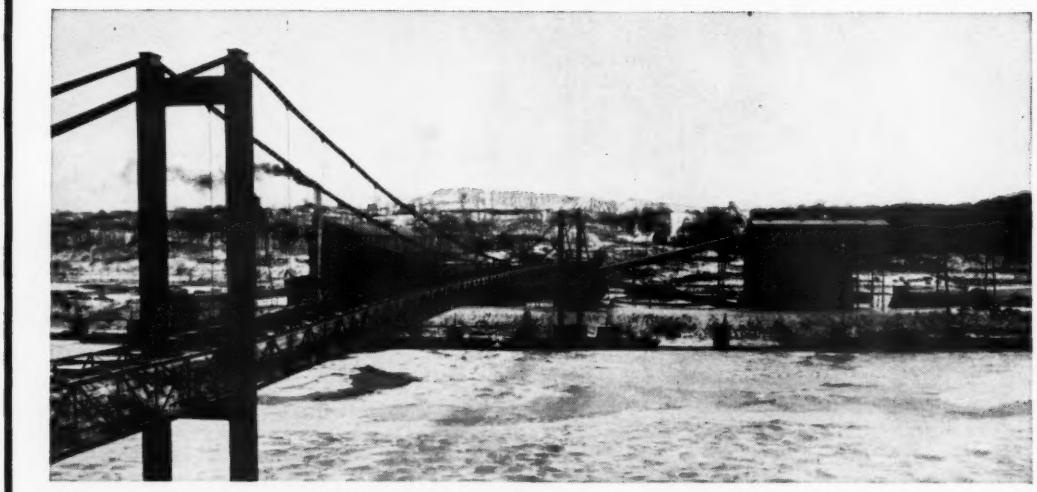
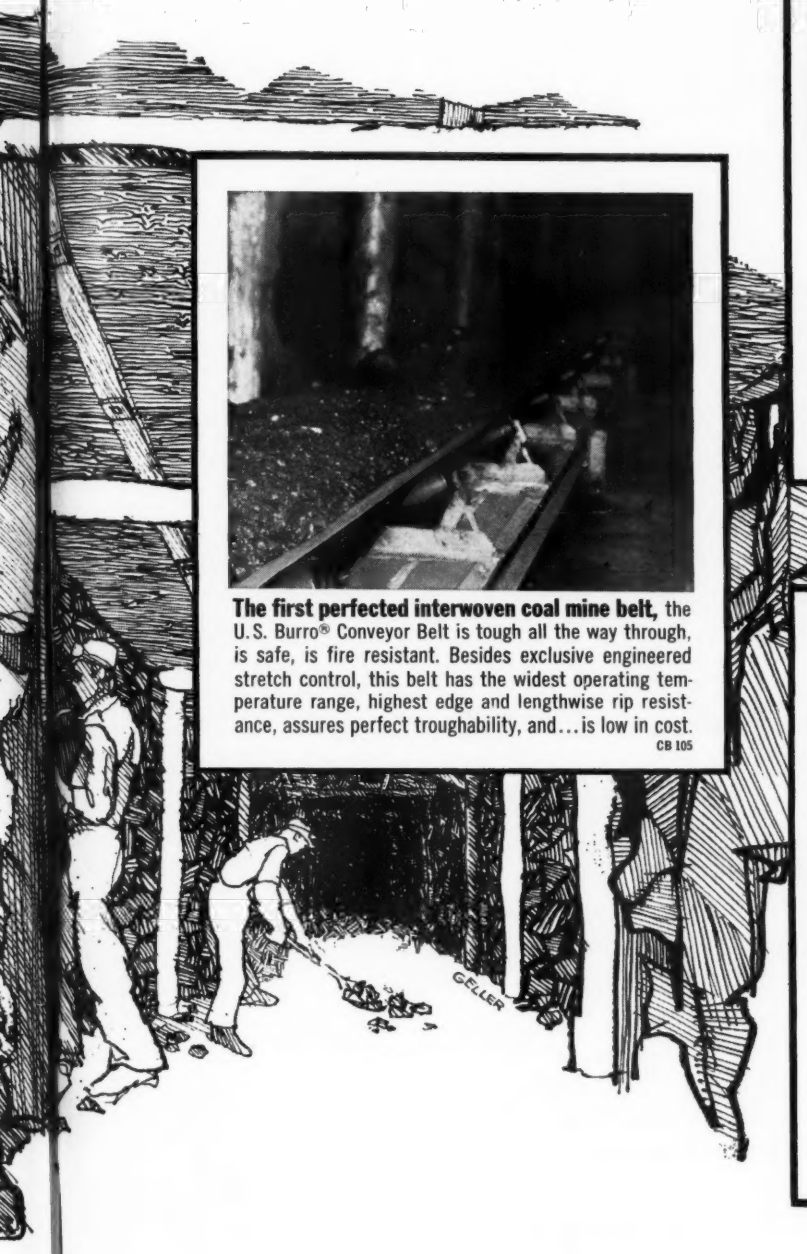


Coal crosses a river on a 3,870-foot US Conveyor Belt at Jones & Laughlin's La Belle, Pa., preparation plant, one of the world's largest. The US Belt, supported by the world's longest belt-conveyor bridge, has been carrying run-of-mine coal since 1948 without a breakdown. In this time it has carried over 50 million tons of coal.

CB 106

Wherever the coal industry operates, you'll find US Industrial Rubber Products and engineers helping automate the mining, handling, and utilization of coal, making it the economical energy producer it is.



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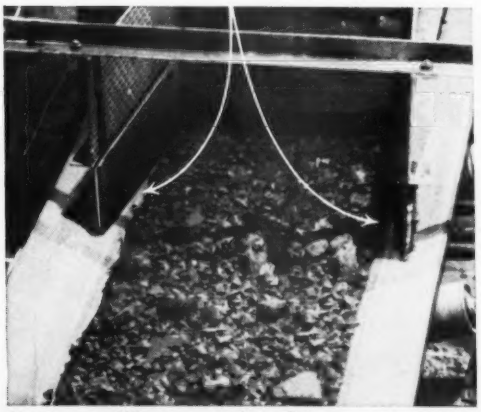
CB 105



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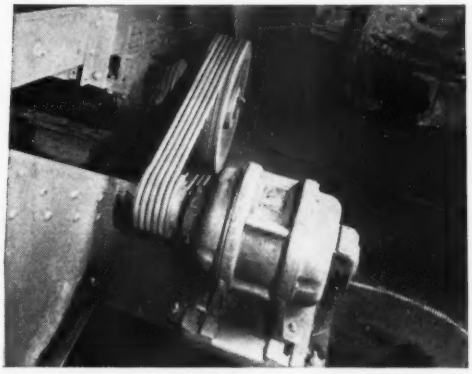

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VB 109

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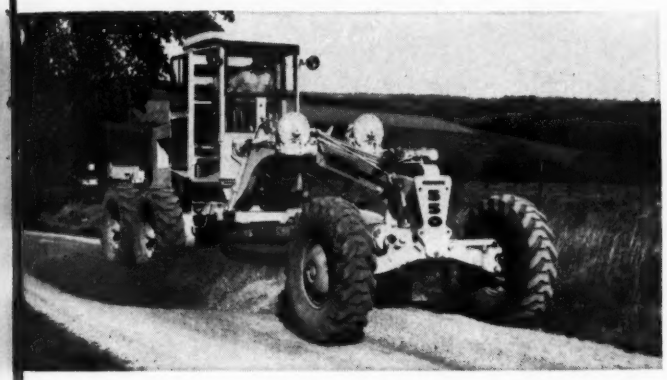
LeTourneau-Westinghouse graders are available in 7 sizes, with horsepower ratings from 85 to 190, weights from 10¾ to 14 tons. All sizes have constant-mesh transmission; 145 and 190-hp POWER-*Flow*® models have torque converter. A variety of matched attachments increase the work range in each size. Major items are: scarifier, bulldozer blade, push-plate, Ateco rear-mounted ripper, snow removal equipment, Jebco Elegrader and Preco Dial-A-Slope blade control.

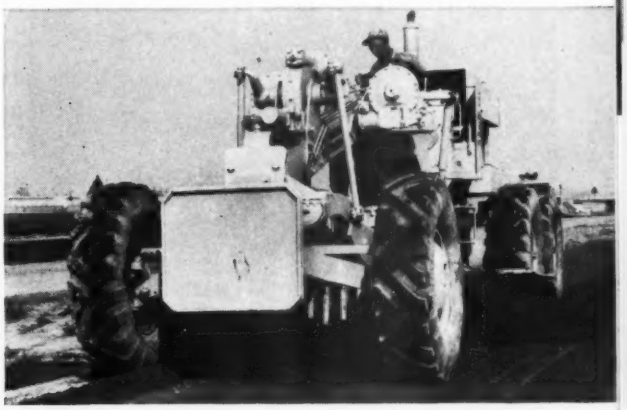
Let your LW Distributor help determine what size of graders will do *your* work most efficiently, cut operating costs, and give you highest return on your grader-investment dollar.

85-hp 330 . . . this economy-priced model has many LW "big-grader" features. Another low-budget LW grader is the 100-hp 330-H.

115-hp 440 . . . biggest-value motor grader in this popular size. 8-ft long, 35-in. high dozer-blade is hydraulically controlled from the cab.



125-hp 550 . . . heavy-duty all-purpose machine. Choice of GM or Cummins diesel engine, as on all LW graders.



145-hp 550 POWER-*Flow* . . . torque converter, infinite speed ranges to 26.4 mph. "550" shown is equipped with Dial-A-Slope blade control. Push-plate and V-type scarifier give it extra job versatility. 660 POWER-*Flow* has 190 hp . . . speeds to 26 mph. G-2395-G-1

160-hp 660 . . . biggest, heaviest grader in the "straight-shift" Le Tourneau-Westinghouse line.

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A Subsidiary of Westinghouse Air Brake Company

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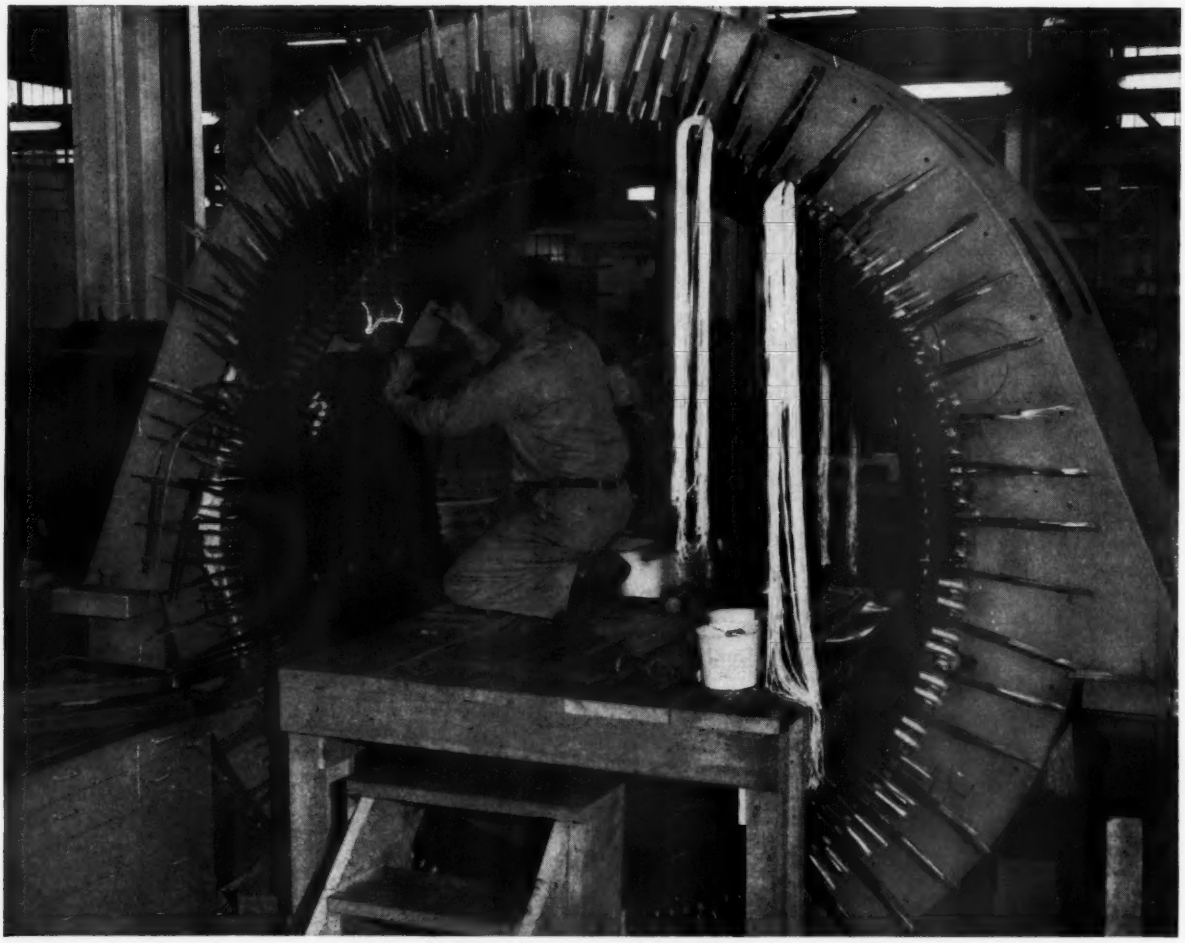

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NECCOBOND insulation system protects motors in severe environments

Completed winding passes 23,000-volt test.

Provides optimum resistance to moisture, heat, corrosive atmospheres

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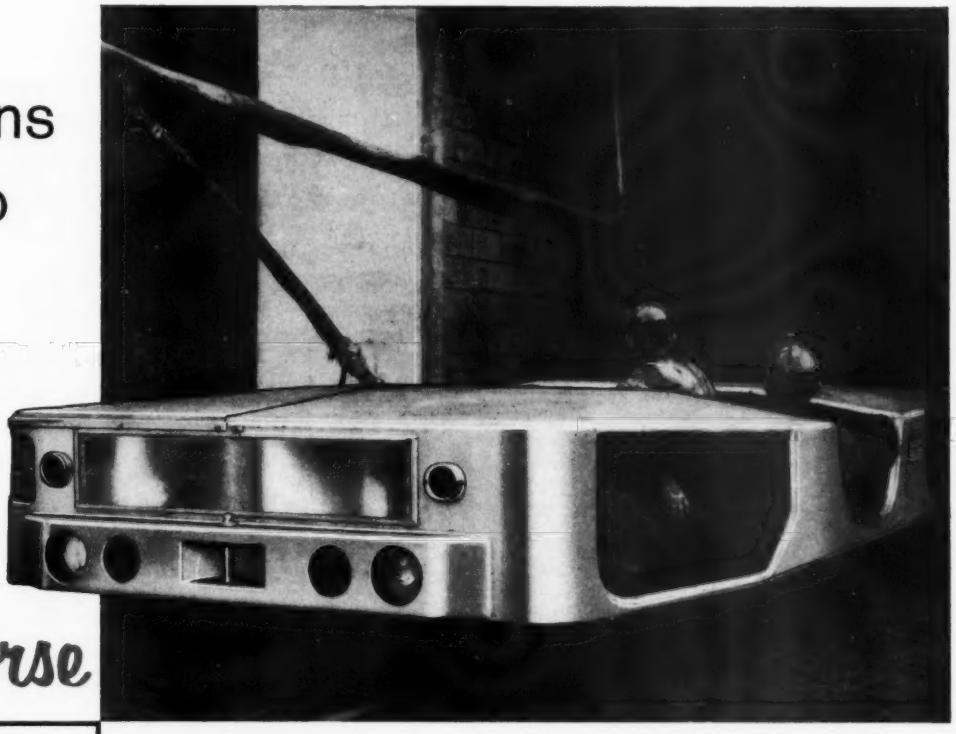
Reasons why so many mines use the



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4. POWERFUL—Self-propelled by sturdy traction-type 15 HP gearmotor (250 or 550V—DC).
5. RUGGED—Quality built to withstand the hard usage of 'round the clock mining!
6. LOW MAINTENANCE—Simple design—easy accessibility.
7. OPTIONAL FEATURE—Electric dynamic brakes for plus safety on severe grades.

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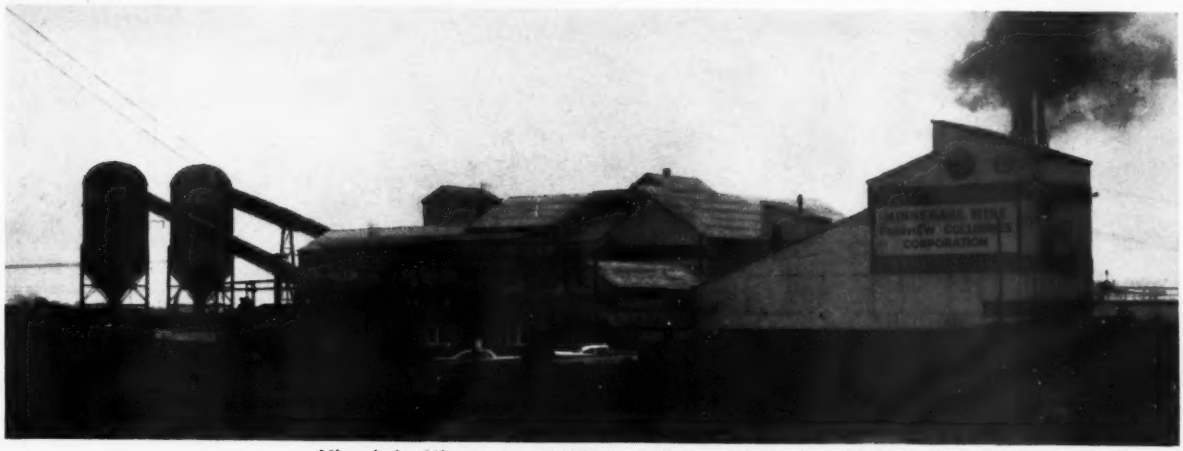
Specialists in Coal Mining Equipment

THIS IS MARION QUALITY

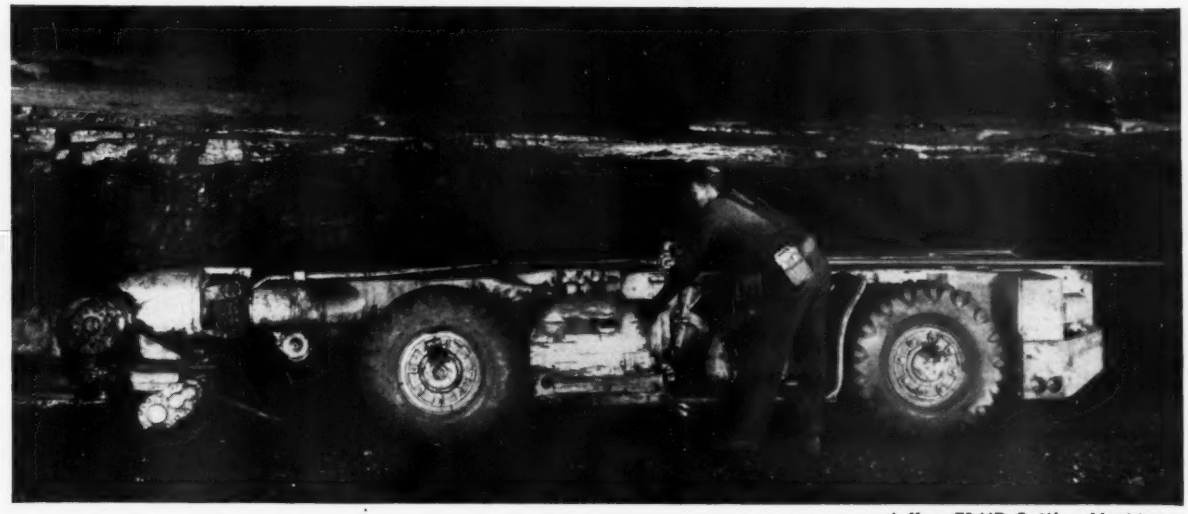
Slam the dipper of a mining excavator against a bank and begin to hoist through tons of unshot ore and strange things begin to happen. Cables whip taut, machine pivotal points are thrown under massive stresses and the entire unit is subjected to component-destroying vibration. It takes exceptional designed-in strength to resist such forces over the profit life of an excavator. Marion gives it to you. In almost 2″ of solid, high-strength alloy deck plate for upper machinery support, in the 9-yard Type 181-M, for example. In machinery supporting members that are welded integral with the deck for absolute rigidity. In heat-treatment of the *entire* frame to relieve invisible weld stresses. In careful placement of components to spread operating stresses over a large area for additional stability. The long way around? Perhaps. But the safest—for machine and operator. Marion Power Shovel Company, Marion, Ohio. A Division of Universal Marion Corporation.

MARION



Minnehaha Mine averaged 2700 tons of raw coal per day with two units of Jeffrey equipment working two shifts per day over a period of 22 months.

"Performance miraculous; costs reasonable" with conventional Jeffrey units at Minnehaha



Jeffrey 70-UR Cutting Machine.

Impressive results with Jeffrey equipment—drilling machines, shuttle cars, loading machines, cutting machines—are reported by the Minnehaha Mine of Fairview Collieries Corp., Sullivan, Ind. Management states that maintenance costs have been exceptionally low—and performance way beyond expectation.

SYSTEM PLANNING—The wide range of Jeffrey equipment in use was chosen on recommendations of an experienced Jeffrey sales engineer. While each unit is a solid performer itself, it takes experience to match and integrate the various pieces of equipment to give top performance of the whole mining system. Jeffrey analyzes the complete job—and comes up with recommendations to help you realize low-cost production.

ONE-STOP SERVICE—Standardizing on Jeffrey equipment streamlines maintenance and ordering of renewal parts, too. Minnehaha gets topnotch service from the Jeffrey warehouse in Evansville. Here, replacement parts are stocked for immediate delivery.

Use the Jeffrey system-planning approach —you'll find it pays off. The Jeffrey Manufacturing Company, 958 North Fourth Street, Columbus 16, Ohio.

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O-B Designs for Mining Men

RESULT:

A circuit interrupter that costs less than any other type of cable protection... except the fuse!

MAGNA-TRIP SNUFFS OUT SHORTS BEFORE THEY HAVE A CHANCE TO CAUSE TROUBLE. Ingenious design by O-B engineers results in a simple sturdy unit to protect machines, cables, and men. This safe control-device drastically reduces the danger and expense of cable fires.

VITAL MINING MACHINES PRODUCE MORE WHEN THEY'RE PROTECTED WITH MAGNA-TRIP. This efficient unit reduces damage resulting from shorts and faults in cables. Less damage means less lost labor . . . less lost time . . . less lost production on your jobs.

WHEN IT TRIPS . . . THERE'S TROUBLE. Magna-trip has been designed to allow for normal surge loads without "false tripping." When Magna-trip kicks out . . . there's trouble on your circuit . . . and you've saved damage and delay!

PAYS FOR ITSELF WITH THE FIRST CABLE IT SAVES . . . ALL OTHERS ARE PROFIT. Magna-trips cost less than the ordinary length of cable that it protects. The **first** time that it saves a cable that would otherwise have been destroyed . . . you've paid for your circuit interrupter. In its lifetime, your Magna-trip will return to you its cost many times over.

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NEW, IMPROVED CAT 619...SERIES C...ALL NEW 4-CYLINDER ENGINE... 24% MORE HORSEPOWER...COMPACT...ECONOMICAL...CHOICE OF POWER SHIFT TRANSMISSION, DIRECT DRIVE...COMPLETE UNIT CONSTRUCTION...EASY SERVICING...NEW TIRE SIZE...AIR ACTUATED, LIVE POWER CABLE CONTROL...IMPROVED 18 YD. (14 YD. STRUCK) SCRAPER.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

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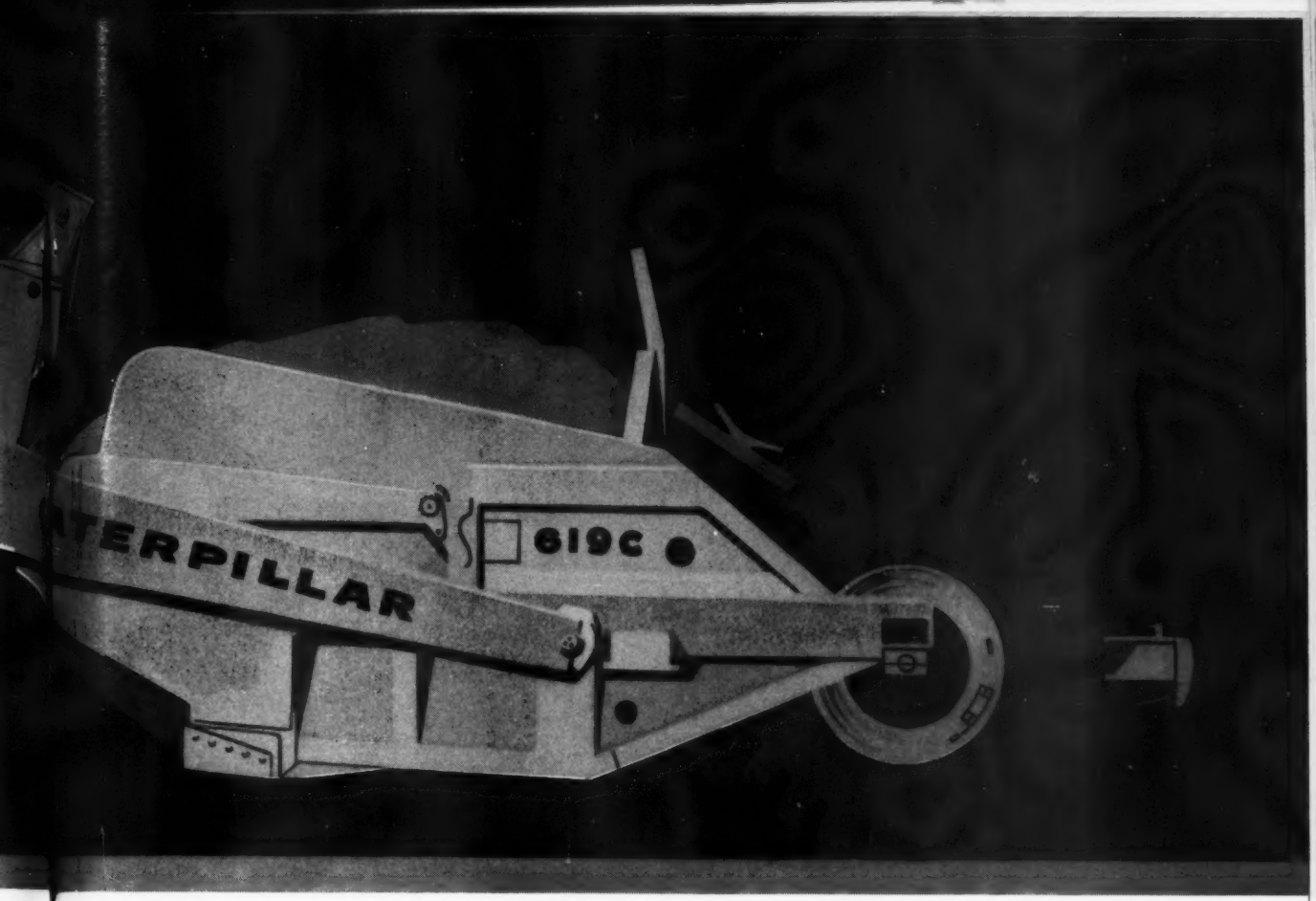
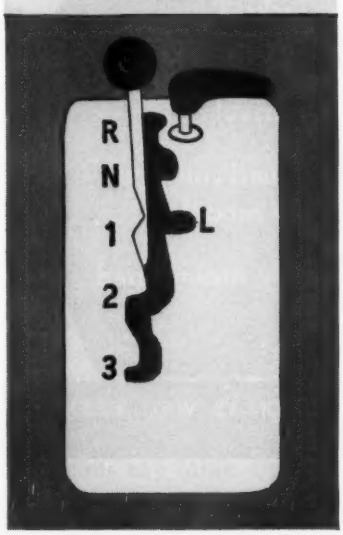
—CERTAIN AS YESTERDAY

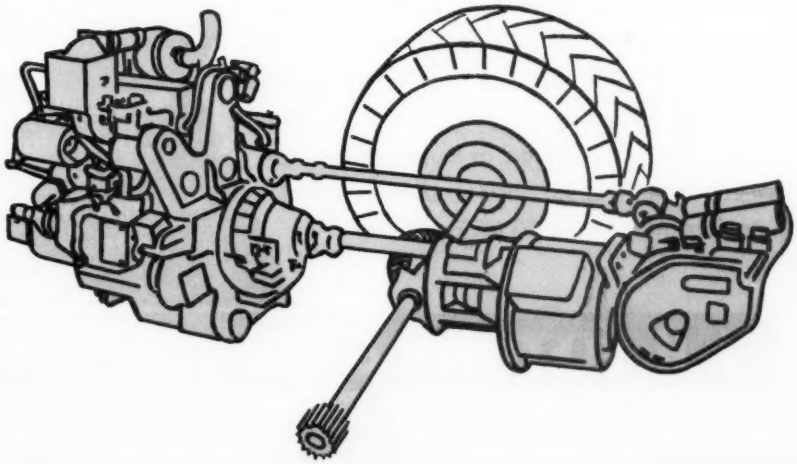




New 280 HP 619C offers choice of power shift transmission for faster, easier operation or direct drive transmission. Air actuated, live power cable control reduces operator effort. New, bigger 26.5 x 29 (22 ply) tires improve roadability. Top speed: 30 MPH. Capacity of matching Lowbowl scraper: 18 cu. yd. heaped, 14 cu. yd. struck. Also available: 25 ton PR619 Rear Dump Trailer built by Athey Products Corp.

New power shift transmission provides 9 speeds forward with just 3 shifts. One lever gives operator instant selection of 3 speed ranges . . . dial indicator tells him **when** to shift. Within each speed range, transmission **automatically** shifts to torque divider drive, direct drive or overdrive to match job conditions. The 619C with power shift transmission always operates at the right speed and power for the job at hand.

New, more powerful Cat D340 Engine (280 HP maximum, 250 HP flywheel at 1900 RPM). This economical 4-cylinder engine burns No. 2 fuel oil . . . has parallel-ported dual intake and exhaust valves and overhead camshafts for most efficient operation . . . has pressure ratio controlled turbocharger and aftercooler. Swingaway dash and pivoted crankcase guard simplify servicing. Unit construction assures easy servicing: engine, transmission, planetary final drives can be removed without disturbing adjacent components.



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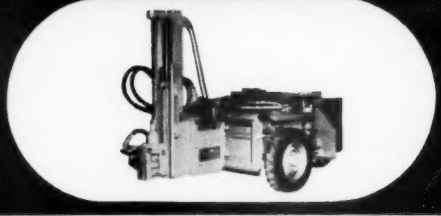
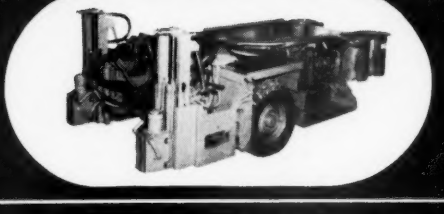
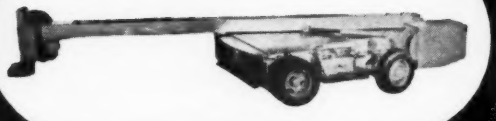


DUAL—



HIGH CAPACITY
SWINGING BOOM—
ROOF DRILLS



24" HIGH
LOW CRAWLER—
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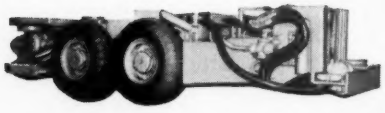

THE superior features found in Fletcher Roof Control Drills produced over the past ten years have been further refined in this new generation of machines. And, *as always,* Fletcher drills cost less to own and operate — and you have the special features *you* need for more capacity in *your* conditions. You would expect as much from equipment built by specialists in Roof Control equipment for over 10 years.

- Improved high-thrust mast feed—with new "hoseless jacks"!
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Pace-setter in profitable hauling

Meet the Mack that meets the challenge of the toughest hauling jobs — the B Model Mack. Truck or tractor, this is the unit that has firmly established itself as the favorite among operators all over the nation.

What's more, when you buy a Mack B Model you get Undivided Responsibility. Undivided because Mack practices Balanced Design, an exclusive Mack engineering concept assuring that every major component in a Mack is built by Mack to operate with every other as a strong, sweet-running unit.

The net result of this painstaking manufacturing process is a vehicle that outlives, outperforms and outeconomizes any other. Operators running B Models will tell you these Macks can't be beat for long, trouble-free operating life and low upkeep costs.

So remember, no matter what hauling job you have in mind, there's a Mack B Model that will do it better and for less over-all cost. See your Mack branch or distributor for actual performance data. Mack Trucks, Inc., Plainfield, New Jersey. Mack Trucks of Canada, Ltd., Toronto, Ontario.

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MACK
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"The 21000 diesel made about twice the shovel out of this machine"

. . . reports the operator of a Bucyrus-Erie 54-B shovel owned by Lige Dickson Co., Tacoma, Washington. "It has lots of steady power," the operator adds — "with fast recovery and excellent lugging power."

"It's a good engine," agrees the owner. "It not only increased production, *but dropped fuel consumption 40%!*"

There must be something to it when user after user makes enthusiastic reports like these about Allis-Chalmers "Thousand Series" diesels. Wouldn't it pay you to find out from your dealer what they will do for you? Allis-Chalmers, Milwaukee 1, Wisconsin.

BC-38

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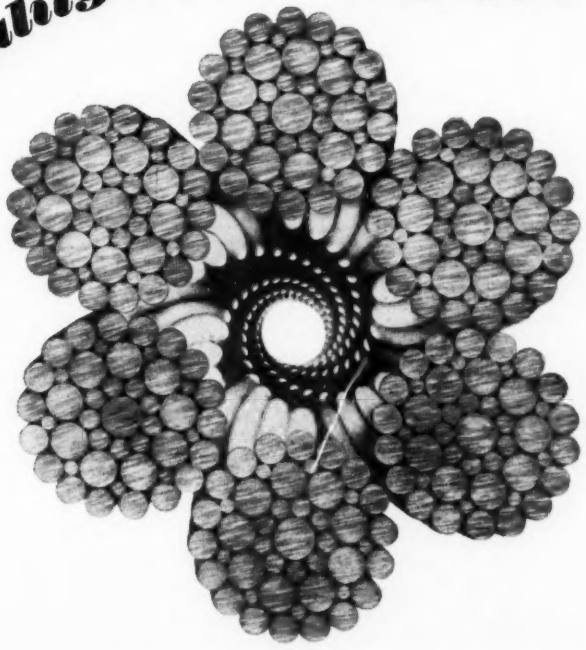

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The potash plant engineering and construction performed by Stearns-Roger in recent years exemplifies the leadership provided by S-R engineers in the chemical and metallurgical industries. In the United States and Canada, Stearns-Roger is the principal source for potash plant design, fabrication and construction . . . new facility or plant modernization.

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DESIGNERS CONSTRUCTORS MANUFACTURERS

The Realities of FREE ENTERPRISE

By E. M. NAUGHTON
President
Utah Power & Light Co.

"Freedom is not bestowed, it is achieved. It is not a gift, but a conquest. It does not abide; it must be preserved."

Albert E. Bowen

INASMUCH as both the mining and electric power companies have been on the Government-interference firing line for some time, we are more aware than most industries of the dangers facing us. Too many businessmen are blindly complacent. They apparently believe "it can't happen here" even though in many respects, it already has happened.

Unfortunately, far too many businessmen are becoming too cagey—perhaps a little ashamed—to consider themselves capitalists. To me capitalism is a wonderful word and primarily responsible for the economic success of this nation over the last 185 years. Specifically, it is a system in which the ownership of land and natural wealth, the production and distribution of goods—the operation of the system itself—are effected by private enterprise and controlled under competitive conditions. The right to exercise initiative and to succeed; to enjoy the benefits of that initiative; the right to fail; the right to accumulate wealth with which to produce and to provide employment; the right to compete, which stimulates and controls us; and the right to live in an orderly society with its self-imposed rules of conduct, with freedom of thought and speech—all of these have made America.

While our forefathers gave us a wonderful system of government, this is no assurance that we'll always keep it. We must appreciate it—we must work to preserve it—we must teach those who follow us to love it. We're getting pretty well off the track and it's high time we faced the "Realities of Free Enterprise." We seem to feel secure under our Constitution and Bill of Rights. History, however, should dispell any feeling of complacency. We are not the first people with sacred documents protecting the rights of the individual. Great past governments have thrown up even stronger safeguards against dictatorships only to see the very foundations destroyed as people for the sake of security permitted more and more power to be concentrated in an all-embracing central government.

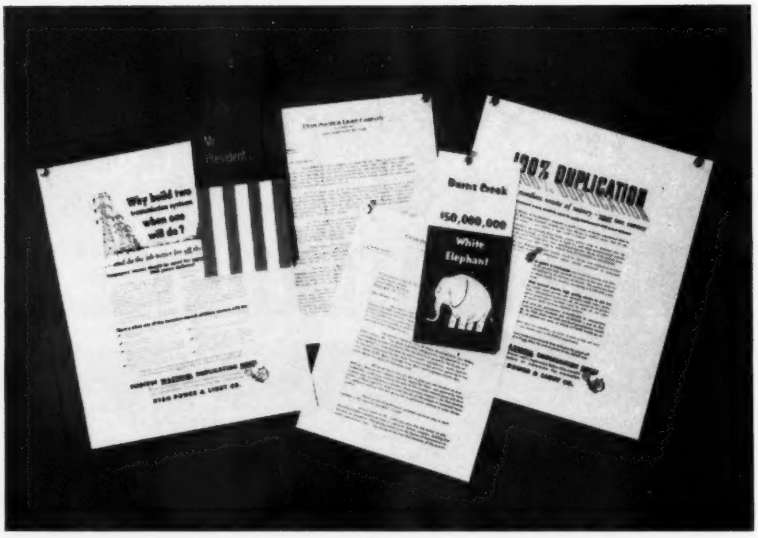
In lieu of editorial comment this month, **Mining Congress Journal** presents this article by E. M. Naughton, president of Utah Power & Light Co. His discussion bears directly on some basic principles of the American free enterprise system—showing how public complacency and concentration of Governmental power have eroded that system to an alarming degree.

Government Can Only Give What it Takes Away

We seem to have forgotten the centuries of conflict that led to the freedom we have enjoyed. We should have learned from mankind's experience the folly of believing that any government, given excessive power, will long remain benevolent. Government has nothing to give except that which it has first taken away.

We in the electric power business have observed with considerable concern for nearly 30 years a movement towards a central government assuming responsibility for electric power service that had previously rested in the hands of people in specific areas. The 1920 Socialist Platform, under which Eugene Debs ran, contained a rather mild plank urging that all business essential for the existence and welfare of people, and all industries operating on a national scale, should be taken over by the nation.

The American people had little interest in the program the Socialists offered and Socialist leaders realized that little, if any, progress could be made in taking over America through the ballot. Until that time advocates of Socialism had relied either on outright revolution or upon a change in government through election. The younger element of the Socialists in America became dissatisfied with this lack of progress and one of its bright members, Stephen Rauschenbush, concluded that American workers were getting along too well and would never support the Socialist's idea of a worker's revolution. He proposed that an effective way for Socialism to



American businessmen should do all in their power to defend the free enterprise system on all levels. The above items—newspaper advertisements, brochures, letters to customers and congressmen—illustrate a portion of Utah Power & Light Company's efforts along these lines during the past six months

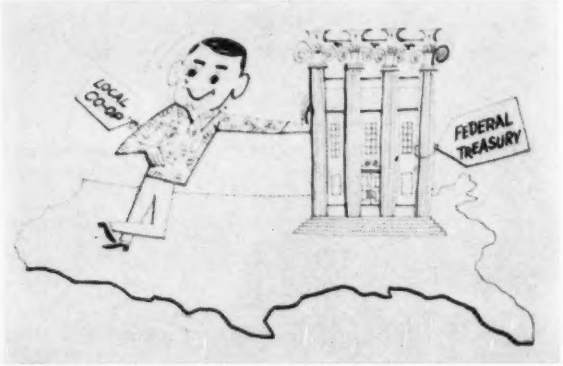
get ahead in America was not through revolution, or by ballot, but to sell it a little at a time. In the early 30s the Socialist Party began infiltration of government agencies with the avowed purpose of indoctrinating those in political authority with Socialist philosophies. Rauschenbush contended that:

> "One good man with his eyes, ears and wits about him inside the department . . . can do more to perfect the technique of control over industry than a hundred men outside. . . . If he finally decides to leave the government for labor, he will bring something more than general willingness."

Government Electric Capacity Expanded 14 Times in 30 Years

Despite the fact that investor-owned utilities, which have given the American people electric power service second to none in the world, have spent in the last 30 years $41 billion—currently at the rate of $4 billion a year—have consistently installed new equipment and developed new methods and techniques to better utilize fuels, all to lower their charges per unit of energy to their customers, the Federal government or it agencies, who in 1930 provided less than 1 percent of the total electric capacity in this country, now, through the expenditure of tremendous portions of taxpayers' money, operate 14 percent of this country's electric capacity.

Much of it began shortly after a new administration came into power in 1933, when there was created the Tennessee Valley Authority, three years later the Rural Electrification Administration, and in 1937 the Bonneville Power Administration. These agencies of a central government began the assumption of responsibility for supplying electric power to definite regions, something that before had rested in the hands of people operating in a free society.



Rural Electrification Administration "co-ops" are an excellent example of the threat to free enterprise. These organizations "lean" on the federal treasury for two per cent money, placing their competitors at a distinct disadvantage

The Tennessee Valley Authority was to improve the navigability of streams and to develop agriculture and industry in the Tennessee Valley. No mention was made in the preamble of the Act of power supply. Nevertheless it has, in some 25 years, developed into the largest single electric power system in the United States—10,000,000 kw—serving the state of Tennessee, parts of the states of Mississippi, Kentucky, Virginia, North Carolina, Georgia and Alabama. No investor-owner utility remains in that area. U. S. taxpayers have loaned in good faith about $2 billion to build electric facilities in that area. Laws under which the project originated required that at least $1.2 billion be repaid to the Treasury over a 40 year period. Congress abrogated that obligation last year granting TVA the right to sell prior lien bonds to finance more and more electric power facilities. This, in effect, makes a gift of at least $1.2 billion of American taxpayers' money to people and industries in the Tennessee Valley.

Public Paying for Uneconomic Operation of Power Plants

In 1937 the Bonneville Power Administration was created, originally to market power from the Army Engineers' Bonneville Dam development on the Columbia. There was no market for the power at the time, but later World War II became imminent, and because we needed great quantities of aluminum, our government induced construction of large aluminum plants in an area far removed from any aluminum ore supply through ridiculously low and highly subsidized rates. Since then there has been an almost continual power shortage because of these rates and the government has continued to develop the Columbia, building Grand Coulee, McNary, Hungry Horse, etc. and BPA now has jurisdiction over about 6,500,000 kw of electric capacity which cost American taxpayers $2.6 billion. The subsidized rate at which it sold power over two recent years has put the government in the red by about $10 million.

The third government agency created in the 30s, and perhaps the most vicious of all from a businessman's view, is the Rural Electrification Administration. It was created in the great depression to bring power to American farms where electric service was not then available. It was admittedly a subsidy, designed to loan $360 million over nine years to cooperatives in various areas to build electric facilities. The interest rate of

two percent set in 1944 is still in existence. In 25 years this agency has loaned not $360 million, as originally planned, but $4 billion. REA's Washington staff consists of some 1000 people and because practically every American farm has long since been served, these people have had to do some sales work in order not to be out of a job.

Industry to be Lured into Co-op Areas

While the Act clearly intended that cooperatives purchase their power supply from the nearest central station source, the individual electric co-ops have begun to organize among themselves, creating super co-ops, with attendant large steam generating plants and transmission systems with great capacity available, all at the expense of the American taxpayer. Those in Washington administering the investment plan to entice all types of industry into co-op areas, and the Administrator has distinctly said that co-ops have a responsibility to bring industries into their regions. Almost 90 percent of new co-op customers are not farmers, and I regret to report that some industries in their greed for a better competitive position have egged the co-ops into such action.

Yes, the ideas of the Socialists have been advanced, maybe unwittingly and maybe not, in some departments and various agencies of our Federal government. Some of these agencies are flirting with one another with a common purpose of ultimately integrating Department of Interior projects, other Federal government projects, such as TVA and Bonneville Power, with super REA projects. Interior has been working on plans to develop the Missouri Basin which in addition to hydro would encompass a great number of steam plants. (Steam plants are not new in government thinking because more than three-fourths of the power capacity in the Tennessee Valley system is by fuel burning plants.)

We have the Federal Southwest Power Administration involving government plants and transmission lines on rivers in Texas and Oklahoma and the Southeastern Power Administration involving, among others, the famous Santee Cooper white elephant.

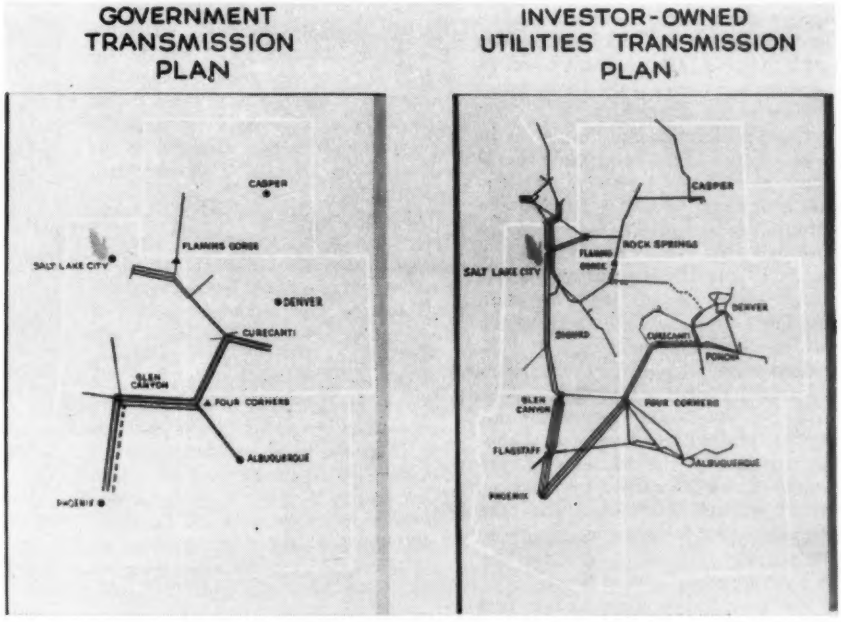
We have super cooperatives in Texas, New Mexico and Colorado and strong efforts are being made to enlarge them. Our industry is now coping with a nine member super co-op planned for the Dakotas.

Press Releases Infer a "Power Gap" Exists

In 1959, the late Senator Murray of Montana introduced what became Senate Resolution 71. This would require that the Interior Department conduct a comprehensive survey of the electric power situation in the United States and recommend legislation to assure development and organization of a bulk power supply, as well as recommend integration presumably through federally owned transmission lines, federal government or its agency projects, REA projects and investor-owned utility systems. This legislation was vigorously sponsored by Clyde Ellis, a lobbyist for REAs, Alex Radin of the American Public Power Association and Gus Norwood of the Northwest Public Power Association.

To enlighten members of Congress the Senate appointed a committee to tour Russian projects. This committee was accompanied by the public power advocates just mentioned. Through press releases following the Russian tour, one would infer that America was falling behind Russia in plans and techniques and that unless our program were stepped up we would soon lag behind Russia. Naturally with a nation considerably behind us electric-power-wise a given added capacity in relation to a much smaller base gives a high percentage of increase; however, the fact remains that we at our current level with over 183 million kilowatts are continuing to add capacity faster than the Russians so that the gap is actually increasing.

At least one of our political parties has promoted federal power development. At a Western Political Conference in Albuquerque a proposed platform plank on "energy" read in part as follows: "Foster development of efficient regional giant power systems



The Bureau of Reclamation has proposed construction of high voltage transmission lines to transmit electric power from Colorado River Project dams to "preference" customers. The government chooses to ignore the fact that existing or planned transmission lines of investor-owned utilities in the five Upper Colorado River Basin states would do the job of transmitting power to "preference" customers better; would do the job at the same cost to power consumers; would save the taxpayers of the nation $136 million in construction costs alone; and would contribute taxes to federal, state and local governments

from all sources, hydro, thermal and nuclear with utility responsibility to supply low cost electricity at wholesale to all retail electric systems." This plank was sawed off some by the time the final platform was evolved in Los Angeles because thermal plants were omitted. The other party had no specific plank with respect to electric power in its platform, however, it has to some degree also promoted development of federal power projects.

Preference Law Customers Pay No Taxes on Electric Bills

What is the motivating force behind government encroachment into the power business? What is its sales appeal and who are the salesmen? For one thing, almost everybody uses electricity and some politicians apparently feel that they can reach more voters by making it a political issue. For another, we have what is called the "preference law" which has done much to cause certain people to act as vigorous salesmen for the Department of Interior and the REAs.

This "preference law," which is in most of the Acts creating Federal water and power projects, provides that if a municipality has its own distribution system and sells directly to customers, or where an REA or a Public Utility District has an electric system which directly serves customers, they have the first right to the purchase of power generated at Federal government or its agency power plants. Not many people are familiar with the current preference law nor are they particularly interested. About 80 percent of the citizens of the United States are served by investor-owned utilities and know that the rates they pay for electric service include taxes imposed upon the utility as a corporation serving them.

The so-called preference law first came into existence with the Reclamation Act of 1906, which Act stated that where electric power be generated as an adjunct to development of water and land reclamation, preference would be given to "municipal purposes." A municipal purpose was to pump a city water supply, sewage or to operate municipal street lights. In the 30s this original law was perverted into its present form to give preference to any customer served directly by a municipality, an REA or a Public Utility District. It is interesting to note here that 80 percent of the people in the United States who pay taxes as an element of their electric utility bills, which taxes are a source of government funds to build government projects, have rights subordinate to citizens who pay no taxes in their electric bills.

Private Utilities will Transmit Government Power

The investor-owned utilities in Arizona, New Mexico, Colorado, Utah and Wyoming are confronted with an interesting problem. The states contain many natural and industrial resources, many of which have not even been developed. They will be put to use, and as the economy of the region grows more water also must be developed. Some water is available by harnessing the Colorado River through storage reservoirs, and where you have a dam and falling water, you have energy potential and logically electric generating capacity should be installed at the dams. The Colorado Project Act was passed in 1956 and currently a total of 1,000,000 kw of electric capacity is under construction in northern Arizona and northern Utah. The Act requires that this power be marketed at a price which will repay in 50 years the cost of the electric facilities and also aid in the construction of water development features.

The area's utilities promoted the enactment of the legislation, offering categorically to build transmission lines to carry energy to markets and to integrate government projects. For five years these utilities have been coordinating their long range plans. They have projected their loads for 20 years hence and have come up with a combined peak of 20,000,000 kw for 1980—some three times today's figure. The maximum potential electric capacity that could be developed on the Upper Colorado will be about 1,500,000 kw and these utilities, in making their plans to meet their requirements over the next 20 years, have designed transmission systems not only to meet their requirements and to integrate their systems to the benefit of their customers, but also to fulfill their promise of transmitting to market government power.

Is Interior in Competition with Private Utilities?

The utilities' transmission plans also recognize the rights of certain people under preference laws and the companies have agreed to "wheel" to preference customers. These plans have been announced to the Bureau of Reclamation, reasonable rates have been quoted to the government for wheeling power, yet it is quite obvious that the Department of the Interior considers itself competitive with these investor-owned tax-paying utilities and will undoubtedly exert every effort to get money from Congress to construct transmission lines. On the other hand, the utilities have announced their plans to construct in definite years specific high voltage transmission lines. Utah Power will construct its part of those lines and will fight before Congressional committees any attempt on the part of any government agency to obtain funds to parallel or duplicate its lines. Other members of the Rocky Mountain utilities group will doubtless do the same.

The utilities' plans for these transmission lines will not only relieve the Federal government of spending over $100 million, but the taxes they will pay as a result of their construction will yield to the Federal government ten years hence through income tax payments $1.1 million a year and to state and local governments $2.1 million per year. Of course, practically no taxes are paid by municipalities, Public Utility Districts or REA's

Much of government power advocates' early success, and they continually hammer on it today, is that the rivers of this country belong to the masses of the people and that the people should have first preference to government power at the lowest possible rate. If we pursue that thinking we disassociate water from land; then do not all the mineral resources of this country, even perhaps the air we breathe, belong to all the people?

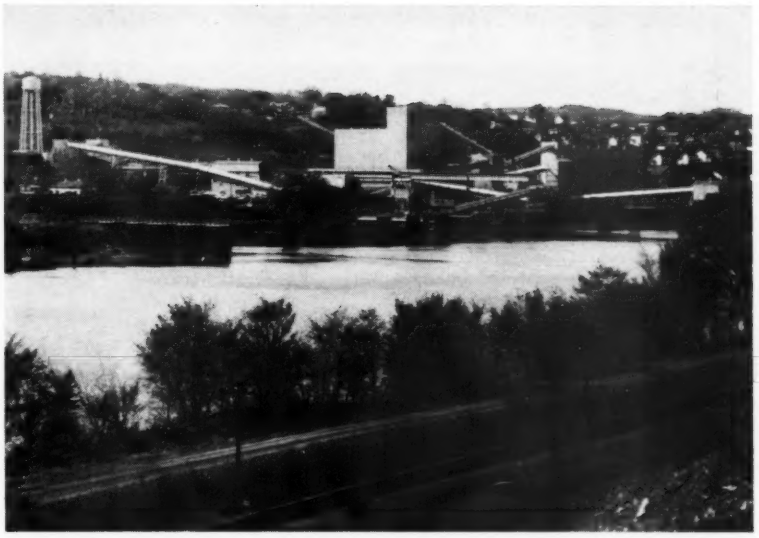
The Only Source of Revenue is Taxes

If the government should take on the responsibility of furnishing power, then why wouldn't the advocates of such procedure take on the sales job that all the mineral resources and fossil fuels belong to the people? All fissionable material now mined must be sold to the Federal government, and what a problem we will have unless the law be changed when 25 years from now, of necessity, new generating capacity installed at that time will be fired by fissionable fuels.

Along this line there was a plank in the platform of a major political party in the recent campaign which reads: "Water, timber and grazing lands . . . energy, minerals, even pure air—are feeling the press of enormously increased demands of . . . growing population. Natural resources are the birthright of all the people."

It has always been an enigma to me why municipalities, counties and states do not wake up to the fact that

(Continued on page 32)



Maple Creek's location on the river allows washed coal to be loaded directly into barges for economical river shipment

Planning for Efficient Cleaning Plant Operation

What was done to insure maximum efficiency for U. S. Steel's Maple Creek preparation plant before it went into production?

By JAMES B. GIROD
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"IT is impractical to plan for efficient cleaning plant operation before actually putting the plant into service and discovering operating problems as they will really exist."

In this day and age that statement should only be uttered just previously to signing a statement of bankruptcy. If those responsible are willing to expend a reasonable amount of energy, and seek advice and constructive help from the sources available to you, any operation can be engineered and planned prior to actual service so that minimum delays and maximum efficiency can be obtained.

This article will show U. S. Steel Corporation's efforts to insure maximum efficiency for the Maple Creek preparation plant before actually placing it in operation.

Plant Handles Output of Six Mines

Maple Creek preparation plant is located on the Monongahela River approximately 20 miles south of Pittsburgh, Pa., with the mine portals for Maple Creek mine, raw coal bins, blending bins, preparation plant, coarse refuse bin, river barge loading docks, and barge unloading docks, terminating in the Borough of New Eagle, Washington County, Pa.

The plant is located at the Mingo-Maple Creek reserve of the Coal Division of U. S. Steel. This reserve has been idle since National Mining Co. discontinued operations in 1927.

Construction of surface facilities for re-entry into the mine and the new preparation plant began on the site of an old ball park in May 1957.

Underground rehabilitation for four entries driven some 30 years previously and 8370 ft in length started on January 31, 1958. Generally, these headings were driven eight and nine ft in width by hand mining. Rehabilitation included "squaring up" haulage entries to a 12-ft width.

Raw coal handling facilities for the Maple Creek mine product were completed and placed in operation on May 6, 1959, when the first solid coal was loaded in the mine.

Preparation facilities were completed in November 1959 and placed in full operation almost immediately. This was possible since an electric barge unloading crane had been installed as an integral part of the plant, so that the production from five up-river mines could be processed, as well as the then limited production from Maple Creek mine.

Prior to construction of the Maple Creek preparation plant, the output of these five mines had been shipped by barge to the Clairton Works of U. S. Steel, for use in the manufacture of by-product coke.

Site Chosen Has Many Advantages

In planning the location of the preparation plant, a decision was made on the basis of favorable handling and transportation of raw and washed coal:

(1) The coal seam to be mined outcrops at the plant location which allows trip haulage of raw coal from the Maple Creek mine.

(2) Its location on the river allows the washed coal to be loaded directly into barges for economical river shipment.

(3) A railroad mainline track passes through the plant, and the plant layout was so arranged that rail loading is possible.

(4) Location on the river permitted planning for handling and processing of raw coal from U. S. Steel mines shipping unprepared coal in barges.

(5) Truck shipments are possible because a main highway passes by the plant.

In addition, location on the river made the water supply for the plant

readily available.

One drawback at the location selected was the lack of a refuse disposal area at or near the plant site. The nearest available area which would provide for disposal of both coarse and fine rejects is over three miles from the plant site at a location referred to as Ginger Hill.

After considering several alternate possibilities, the decision was made to excavate a 411-ft shaft at Ginger Hill for the sole purpose of hoisting coarse refuse. Plans were then made to transport refuse underground in drop-bottom mine cars, from a coarse refuse bin located near the mine portals, to a bin excavated at the bottom of the new shaft. This necessitated the underground rehabilitation of three entries, 8300 ft in length, which had been originally driven some 35 years ago. Automatic skip hoists were installed, utilizing the hoist engine and tipple from a shaft mine previously worked out. The skips dump into a surface bin from which the refuse is loaded into carry-all units for final disposal.

In addition, this decision called for the installation of a quintuplex plunger pump at the plant site to move the fine refuse through an extra heavy five-in. steel pipeline, laid in an entry parallel to the double-track underground haulage, and thence up a borehole at the Ginger Hill site to a slurry pond.

The slurry pond was established by building a dam of refuse material with a clay core across a natural valley on the property.

Steel Tubes House Belt Conveyors

Placement of the preparation plant and mine portals in a townsite called for particular emphasis toward constructing facilities with architectural neatness, low noise factors, the absence of dust, and pleasing color scheme.

A major contribution toward these special requirements has been the use of smooth-surface steel tubes for housing belt conveyors. These tubes represent the first construction of this type and were conceived by the Frick District Engineering Department and the American Bridge Division of U. S. Steel.

This design permitted a considerable amount of prefabrication, installation of conveyor decking, and painting, before delivery to the plant site. The basic strength of the tubular design allowed longer spacing between supporting bents, up to a ratio of two to one.

These tubes create a striking appearance and prevent the escape of dust to the outside atmosphere where it might become objectionable. Housekeeping in the tubes is greatly simplified.

To effect good dust control within the plant, a series of collectors were installed at crushers and transfer points. Insulation was installed to eliminate virtually all noise from the plant.

Raw Coal Ash Varies From 11 to 35 Percent

Contemplated initial processing of the production from six different mines with varying raw coal ash led to the construction of a concrete blending bin because a consistent raw feed is required if uniformity of washed product is to be maintained, and maximum plant efficiency secured.

The wide range of variance in raw coal ash, 11 to 35 percent, from the six mines supplying the plant feed, led management's planning to a step beyond the blending bin, prior to actual operation of the plant. On the basis of quality, and the amount of production from each of the upriver mines, a program was established for an electronic computer to provide all possible six barge tow combinations which would provide a consistent blend when unloaded. Positions of the barges in the tows were also specified, to minimize differences in size consist of the raw coals, and to enable efficient handling of the barges in the unloading harbor. This study was carried on with the cooperation of the River Transportation Division, Clairton Works, U. S. Steel, so that a minimum effect would be realized on towboat efficiency, and the end result proved to be extremely satisfactory. This arrangement necessitated rather fine timing on the part of the towboats since the capacity of the unloading harbor was less than the number of raw coal barges to be unloaded each day, and of course, it was not practical to tie up additional barges.

The Maple Creek reserve lies in the Pittsburgh seam, with the coal averaging 65 in. in thickness, overlain with 12 in. of weak draw slate and, thereafter, alternate layers of wild coal and slate. Clay veins and spars varying in thickness from one in. to 2½ ft are frequently encountered. The coal seam is underlain by a slate bottom which generally provides good offtrack operating conditions. Mining plans call for the use of continuous miners and extracting the first draw slate with the coal seam.

In haulage entries, sufficient wild coal and slate is removed above the first draw slate, to enable maintaining a 5½-ft trolley wire height. These methods of mining governed the equipment utilized in the preparation plant, since ultimately the entire plant feed will come from the Maple Creek mine.

Raw Coal Crushed to Minus Five In.—Then Blended

In processing raw coals through the screening and washing units, the feed is divided into four different segments regulated by size.

The first division is made by primary sizing screens which separate all material at 5 in. by 0, 5 by 8 in., and plus 8 in. Five-in. by 0 material is sent direct to the blending bins, 5 by 8-in. material is crushed to minus five in. and then directed to the blending bin, while the plus eight-in. material passes over a shaking-picking table where coal is removed by hand-picking and reduced to minus five in. by the same roll crusher. Plus eight-in. rock is directed to a separate roll crusher, reduced to minus eight in., and rejected.

An operator stationed at the picking table in the screenhouse controls the conveyor belts, apron feeders, and roll crushers from the Maple Creek and Barge Unloader raw coal bins to discharge into the blending bins.

At the top of the blending bins an automatic tripper fills the 72 pockets of the bin, which are divided into six major subsections, in a pre-set sequence. Material is withdrawn from the blending bin by 18 vibrating feeders. Operation is automatic in that six feeders at a time operate on a preset time cycle and follow a definite withdrawal schedule in placing the material on a 42-in. conveyor belt for transport to the top of the washing plant. Here the feed is discharged onto an automatic diverter which distributes to a five-compartment surge bin.

Washing Plant Consists of Three Separate Units

The washing plant consists of three separate units: the cone or coarse coal unit for the 5 by ¼-in. material; the table or fine coal unit for ¼ in. by 100-mesh material; and the Convertol or superfine unit for minus 100-mesh material.

Initial sizing of the feed is by wet-screening on four of five vibrating screens at ¼ in. Five by ¼-in. material is collected on a conveyor belt discharging directly into an 18-ft diam Chance Cone. Sand is added to the cone from an overhead bin by

directing a stream of water into the sand discharge chute.

Cone float coal is dewatered and desanded over a combination of three stationary wedge-wire screens with 1¼-mm openings and three double-deck vibrating screens.

Top-deck material, which is plus one in., is directed to a ring crusher for reduction to minus one in. Crusher product and minus one-in. bottom-deck material are collected and carried on a conveyor belt to the main washed coal conveyor belt leading to the washed storage bin. Cone sink material is removed by an automatically operated trapping arrangement, desanded and dewatered on two double-deck vibrating screens, and discharged onto the refuse belt conveyor.

Minus ¼-in. raw coal from the raw coal vibrating screens, and the water used for screening, are collected in a sump and then pumped to a splitter box which divides the feed equally to two 44-ft diam bowl classifiers.

One-quarter in. by 100-mesh material is raked out of the classifiers, sluiced to four 6-way distributors, and thence to 24 single-deck Diester tables.

Clean coal from the tables is collected in a launder and fed to a 5 by 6-way distributor which feeds five of six solid-bowl centrifugal filters for dewatering. Dewatered cake is collected on a conveyor belt which discharges onto the main washed coal conveyor belt leading to the washed storage bin. Effluent is pumped to the raw coal vibrating screens.

Table refuse is collected and sluiced to a spiral classifier for dewatering, and discharged onto the same refuse conveyor belt carrying cone reject.

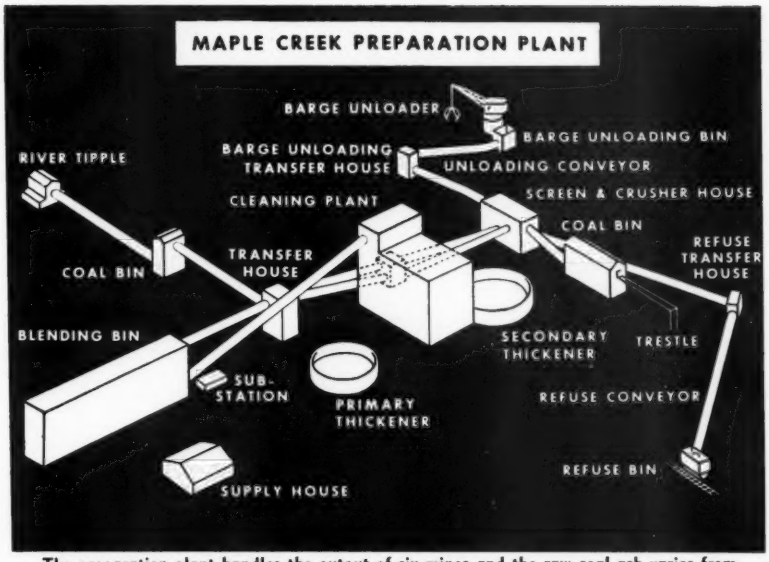
Feed to the Convertol section comes from the minus 100-mesh slimes which overflow the bowl classifiers. This material is removed from the ¼-in. raw coal, as an aid to more efficient table operation, and to improve dewatering in the centrifugal filters.

Bowl classifier overflow is collected in a thickener, to which flocculants are added to produce a clear overflow.

Thickener underflow is pumped back into the plant at approximately 12 percent solids, and split to three conditioners, which mix the underflow with No. 2 diesel oil.

Conditioned material is fed to three banks of four-cell flotation units for separation of the oiled coal particles from the clay slimes. Addition of the oil gives a definite separation, and also aids in dewatering.

Flotation cell overflow is dewatered by three polisher units which produce a cake sufficiently dry for handling, and which is discharged by a conveyor belt onto the same conveyor belt carrying centrifugal filter cake. Effluent from the polishers is pumped to a two-cell flotation unit, and froth produced which is fed to a disc filter for dewatering. Disc filter cake is combined with the polisher cake.

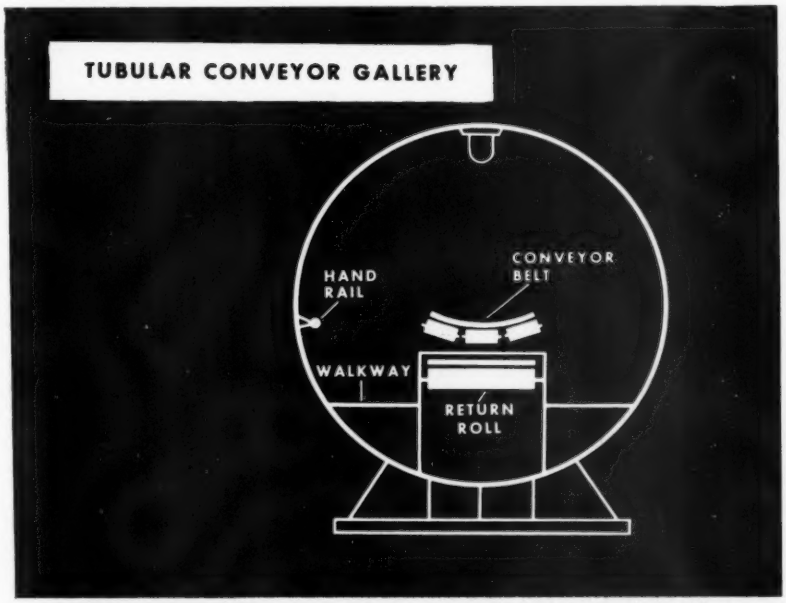


The preparation plant handles the output of six mines and the raw coal ash varies from 11 to 35 percent

Tailings from the flotation units are fed to a thickener to which flocculants are added to produce a clear overflow. The underflow from this thickener makes up the approximately 25 percent solids slurry which is pumped to the Ginger Hill pond.

Clean coal from the three separate processes is transported by the main washed coal conveyor belt, to a storage bin ahead of the river loading docks. At this point is also located the chute arrangement for loading washed coal for rail shipment.

Operation of the plant, beginning with withdrawal from the raw coal blending bins to the clean coal storage bin, and including refuse handling to the mine portal bin, is controlled by an operator from an "L"-shaped panel board located on the sixth floor of the preparation plant. The control center is located adjacent



Steel tubes house the belt conveyors and prevent the escape of dust to the outside atmosphere where it might become objectionable

to the Chance Cone and Diester tables, so that the operator can frequently check these functions.

For river shipment, clean coal is fed from the coal storage bin by two vibrating feeders to a conveyor belt to one of two telescoping chutes, and thence into barges.

Three Automatic Sampling Systems Sample Raw Coal, Feed, Product

Management's planning has now provided the proper blending and equipment to obtain a uniform plant feed and make possible the production of a uniform quality product. To insure the proper balance of all the factors involved, two automatic sampling systems were installed, one for plant feed, and one for washed product. An additional automatic sampling system was also installed to enable individual sampling of each raw coal, prior to discharge into the blending bins.

So that these samples and individual equipment samples can be quickly analyzed for maximum control, a complete laboratory was included in the plant facilities.

All Phases of Manning the Plant Closely Studied

A most important facet of planning any operation for efficiency must of necessity be the manning which will be utilized.

As a phase of the review of the entire plant proposals, and prior to initial operation, the company undertook a complete engineering study of each scheduled occupation to encompass every duty expected from each man down to the smallest detail. Here the industrial engineering department came into the detail of planning each man's duties and worked closely with the engineering department and the future general foreman of the plant who had already been appointed, in resolving, reviewing, and resolving once again, proposed minor changes in physical location of plant equipment and control. As a final result of this comprehensive planning, the flow of material through the plant was improved, and the total manpower concept for 24-hour continuous operation and maintenance was established.

A proposed manning chart was developed for plant wage personnel which detailed the number of men required for each operating shift, each maintenance shift, and the specific assignment of each man to be hired. To pursue this study further, the company's employment office was given this chart and asked to prepare a list of the best possible applicants from men who had worked for the Frick District at other plants, and new applicants. Each prospective employe was then given a series of aptitude tests and interviewed personally by the man who was to be general foreman of the new plant. From these efforts a list of men to be hired was accumulated for each occupation, including substitutes if the man originally chosen became unavailable.

Safety Stressed

Certainly the most important facet of planning for an efficient operation must be in designing for the safety of the men to be employed. Every possible safety feature which could be planned was incorporated in the original preparation plant design and as construction progressed, apparent revisions and additions were included. As a final check prior to completion of construction and operation of the plant, two further steps were taken: (1) a committee composed of engineering, inspection, and operating personnel made a detailed on-the-spot review and were charged with insuring the inclusion of every feature necessary for the complete protection of future plant employes, and (2) every occupation was reviewed to establish a safe working procedure for each man before he was actually hired.

In conclusion, the Maple Creek preparation plant was truly "Planned for Efficient Operation," through encompassing every detail of its functions prior to initial operation. In retrospect, the company has convinced itself that this type of planning most certainly pays off, since the plant has operated efficiently from the very first day it was "put on the line." Other companies can also afford to do this type of planning.

THE REALITIES OF FREE ENTERPRISE

(Continued from page 28)

they have no revenues other than those obtained through taxes from business, commerce and people. Certainly they need more revenues in these inflationary times and in these times of exploding population, particularly in the West. Take for example the school situation. Why should not education associations clearly make up their minds that the capital funds and the operating funds for school systems at all levels are obtained through taxes and that they should, through every means available to them, foster industrial development to bring in corporations who pay taxes and vigorously oppose the construction by the Federal government of any enterprise that industry and people are ready, willing and able to build for themselves. Not too many years ago if the little red school house needed another room to take care of more kids, the citizens just built it, whereas today the feeling on the part of some of the people and many of the teachers is how much can we get out of the Federal government to build our room.

Government Continues to Get Bigger

Too many people in this country have forgotten the principles upon which this nation was founded. Some have permitted the concepts of the application of those principles to decay to an alarming degree. Should anyone doubt that our "Big" government is getting Bigger and Bigger, it is worth pointing out that one out of every seven employed persons in our land is working for Federal, State or Local government. We taxpayers are putting up about $33 billion a year to keep some 8,000,000 government workers employed and the cost is increasing every year. It will cost each American family $610 this year to maintain this vast army of government workers. Ten years ago it cost $340.

When we look into the opinions—and the teachings if you please—of many of the teachers in our schools at all educational levels we sometimes are amazed.

As stated in the beginning, far too many industrialists are ashamed to admit that their enterprise is a capitalistic one—ofttimes owned by literally thousands of investors who have confidence in their companies and managements as custodians for their savings.

We have lost a great deal. However, if we in business would dedicate ourselves toward educating our own employes and people in general, as to what is happening and has happened in this country to the degree that our opponents dedicate themselves, we would be amazed as to our ability to slow down, to stop, and maybe even to turn around this alarming trend. This is a job for everyone interested in saving this great Country. There is no place for selfishness. We must work harder at the job than we have in recent years if we are to make progress.

Practical use of rock mechanics

Changes in the mining method can sometimes effectively strengthen natural ground structures

By SETH D. WOODRUFF
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THIS article deals with the structural behavior of ground around underground openings. There are two types of rock structures which are capable of supporting themselves to span a mine opening. These are the *beam* and the *arch*. When a tunnel, drift, crosscut, entry, room, or stope is self supporting then we may consider that there exists in the ground around the opening the equivalent of one of these structures; that is, either a beam of rock or an arch of rock.

A beam cannot exist unless the rock is intact and possesses some tensile strength. In the intact roof strata typical of many coal mines "beam action" is probably responsible for the ability of roofs of entries and rooms to support themselves. In fractured rock, or in rock which has little tensile strength, a beam cannot exist. In this case the rock derives its self-supporting characteristics from "arching effect." A simple "linear arch" is formed when a beam is cut in the center as shown in figure 1. This same beam may be cut transversely in a number of places, and as long as the direction of the cuts does not approach the direction of the maximum shear stress, the "linear arch" will not be appreciably weakened.

The importance of "arching effect" as the main supporting force for fractured mine roof was pointed out by W. H. Evans about 20 years ago. Evans demonstrated by theory and by model experiments that many mine roof rocks behave in the manner of a "linear arch" or, as he termed it, a "voussoir beam."

The term "*arching effect*" as used herein does *not* signify the formation of a vaulted or peaked roof or back. Rather the term refers to the stress distribution within the rock. "Arching effect" signifies that the rock tends to support itself because vertical forces due to the weight of the rock are resolved into diagonal thrust forces. These forces are carried by the rock "abutments" at the sides of the opening.

If an excavation has a vaulted (arch shaped) roof, the rock may form a natural "voussoir arch" which will be self-supporting. The voussoir arch has been used in civil engineering structures since early Roman times. Such an arch consists of a series of shaped rock, or concrete, blocks as illustrated in figure 2. This type of structure forms naturally (without the perfectly shaped blocks) when an opening with an arched back is excavated in fractured rock. For such an arch to exist the rock blocks composing it must be in tight contact and the abutments must be rigid. If abutments yield laterally the center of the arch will sag and eventually buckle and collapse. Such an arch in soft rock tends to compress, or yield, along the thrust line and the resultant shortening of the arch along the thrust line allows it to collapse.

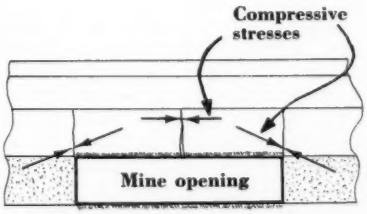
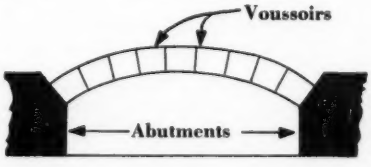


Fig. 1. (above) A simple "linear arch" formed by fracture of the roof beam.

Fig. 2. (below) A typical voussoir arch



The Pressure Arch, Front and Rear Abutments

The unmined mineral ahead of an advancing longwall face, or a retreating pillar line, is subjected to pressure which exceeds the depth pressure (natural vertical pressure). This zone of overpressure is commonly designated as the "front" pressure abutment" or simply as the "front abutment."

Immediately behind the working face is located the zone of least ground pressure. Behind this the ground pressure begins a gradual increase until at some point in the gob (goaf) the ground pressure approaches or exceeds the depth pressure. The rear zone of maximum ground pressure is designated as the "rear abutment."

The actual magnitude of the maximum pressure which occurs at the "rear abutment" is a subject of a considerable amount of dispute. Measurements with pressure cells in British mines have indicated that a pressure greater than the natural depth pressure builds up at the rear abutment and that the pressure then decreases as the rear abutment passes a given point. This concept is illustrated in figure 3(a). Some British observers have compiled figures which indicate that the span of the pressure arch (that is, the distance between

pressure abutments) increases with increased depth of the workings.

Researchers in Germany have not been able to verify the results obtained by the British. One idea of pressure distribution behind a long-wall face (as deduced by Jacobi from extensive measurements at Neumuhl) is shown in figure 3 (b). Here the pressure gradually increases behind the working face until it reaches a value approximately equal to the depth pressure and there is no pressure peak which exceeds the depth pressure.

Measurements made in French mines by Tincelin and Sinou have definitely established the fact that rear abutments do exist in the caved goaf behind retreating pillar lines in the bedded iron ore deposits of the French Lorraine. Careful measurements were made in an entry that was situated beneath the bed which was being mined. The vertical deformation of the entry walls was accurately measured to detect the pressure effects of mining operations in the seam above and existence of pressure abutments was established by these measurements. It was found that the span of a pressure arch in these mines was equal to about 0.4 to 0.5 of the depth of the workings.

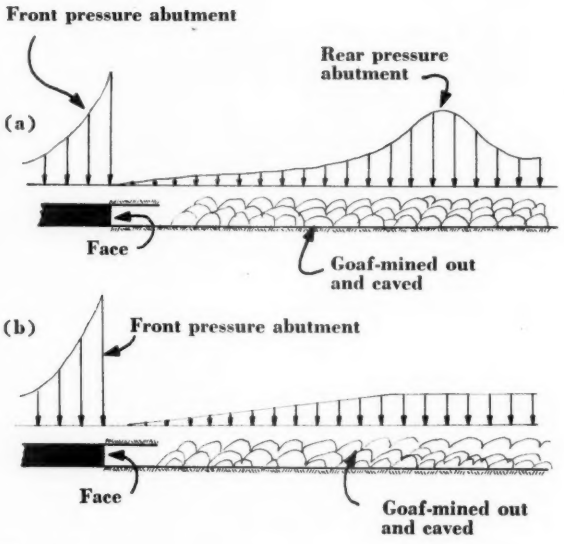


Fig. 3(a) Pressure abutments according to some British observations. (b) Pressures observed in some German mines

Squeeze May Be Avoided by Shorter Level Interval

It is reasonable to assume that this same "pressure arch" with its accompanying abutments exists also around stopes in metal mines where veins are steeply inclined, or even vertical. Figure 4 illustrates the probable nature of the pressure arch over a stope in a steeply dipping vein where natural lateral stress exists in the country rock enclosing the vein.

Probably the squeeze on raise and sill timbers which begins after a stope has advanced a certain distance above a sill is due to the fact that the "pressure arch" has reached its maximum span and the rear abutment has begun to follow the front abutment up the stope. In some veins where hanging-wall is heavy, this squeeze of timber on the sill and at the bottom of a raise develops before the stope back has progressed more than 50 ft above the sill. In other veins, where natural stresses are less, such squeenze may not develop until a stope back is 150 ft above a sill.

In many veins squeeze may not develop at all because the span of the pressure arch is greater than the level interval, or greater than the stope length. The maximum distance which such a pressure arch can span is determined by (1) the strength and structural condition of the country rock and (2) the natural stresses existing in the country rock.

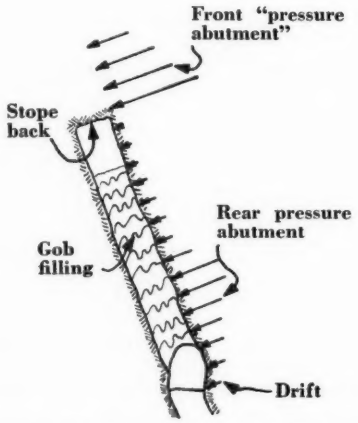


Fig. 4. Pressure abutments in the hanging-wall of a stope

Where such "pressure arches" have relatively long spans it may be worthwhile to shorten the level intervals in order to allow a stope to be worked out before squeeze on raise timber commences. It is also possible that by limiting the length of a stope (along the strike) to a span less than that of the pressure arch that squeeze of timber could be avoided. The effect would be to create abutments on each side of the stope instead of at the top and bottom.

Yield-Pillar Techniques Depend on Beam Action to Abutments

The room-and-pillar system is the most highly mechanized mining system and has proved to be the most efficient system for mining bedded deposits. In most U. S. coal mines the depth of cover over the seams does not exceed about 500 to 700 ft, depth pressure is not a serious problem, and the room-and-pillar system can be used without undue difficulty. Generally, roof spans over rooms will support themselves provided that rock bolts or props are installed.

As depths of operations increase the depth pressure becomes an important problem because pillars tend to crush and soft floor to heave. Experiments with the usual room-and-pillar methods in French coal mines have shown that the limiting depth for successful application of room-and-pillar methods ranged from about 800 to about 1600 ft, with the average being about 1300. Exceptions to this are the potash mines where room-and-pillar methods are used at depths of 2000 to 2300 ft and the coal mines of France's Provence Basin, where coal is mined at depths of about 2000 ft.

It appears that the application of "yield pillar" or "compressible pillar" techniques might allow room-and-pillar methods to be used at much greater depths than at present. Successful application of this method requires that the total width of a developed panel must be less than the span of the "pressure arch." This method takes advantage of the fact that a large part of the weight of an undermined block can be transferred by "beam action" or by "arching action" to the abutments. Pillars must be small enough to yield slightly and to effect a transfer of load to the abutments. When the workings are properly dimensioned the pressure on

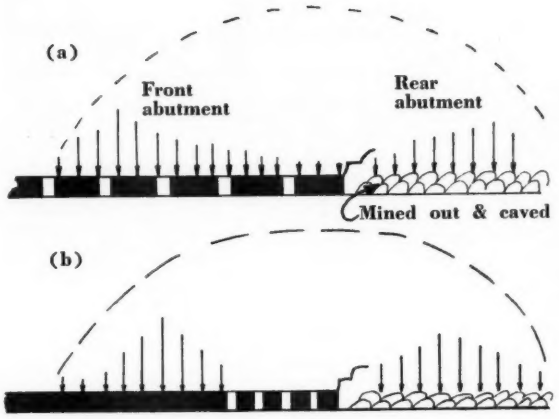


Fig. 5. Yield-pillar methods (a) Pillars are too wide and too much area is developed. The front abutment will damage the developed area. (b) Pillars are narrow enough to yield and to transfer the main-roof load to the abutments. The developed zone is narrow so that it lies entirely between the abutments

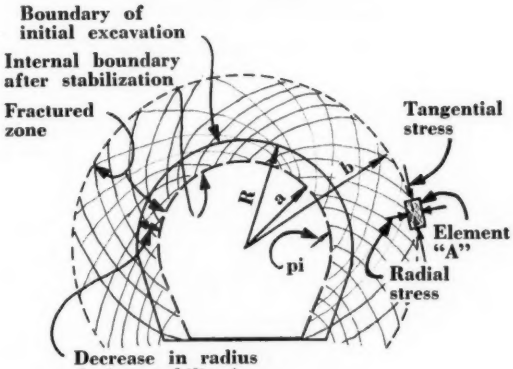


Fig. 6. Equilibrium conditions around a tunnel in over-stressed ground

R=Initial radius of tunnel
a=Final radius of tunnel
b=Radius of fractured zone
pi=Pressure of support on ground

the pillars will not be excessive and roof and floor conditions will be good. Stress conditions which occur with non-yielding pillars are shown in figure 5 (a) while stress conditions which occur with yielding pillars are shown in figure 5 (b).

In French potash mines pillars were at first made 25 ft in width (at depths of 2000 to 2300 ft) but much difficulty was experienced with fracturing of the roof adjacent to the pillars. When pillar widths were reduced to 10 ft the difficulties disappeared. In the Provence Basin, where coal is mined at depths of about 2000 ft, the widths of both rooms and pillars is 20 ft.

The actual span of a pressure arch depends upon the strength and thickness of the main roof rocks. If roof rocks are weak then the span of the arch may be so short as to preclude the possibility of opening a room-and-pillar panel of practicable size. In any case, such a system, when put into practice, would require the most careful day to day supervision, since the whole system is delicately balanced and any misalignment of workings could cause the loss of a panel of workings.

Yielding Supports for Squeezing Ground

Ground which is subjected to excessive compressive stress yields by shearing and squeezes in around the peripheries of drifts, crosscuts, and similar development openings. To prevent any squeeze from taking place would require very strong and rigid supports and the cost of such supports would be excessive. It has been found more economical to design supports which yield by sliding *before* the ground pressure builds up enough to cause them to buckle and collapse.

Whether ground will squeeze or not depends upon two factors: Strength of the ground, and magnitude of the natural ground pressure.

A soft, wet clay, for example, will squeeze in on the supports if a tunnel is excavated in it only a few feet below the surface because the depth pressure on the clay exceeds its shear strength.

A firm clay will stand well for several tens of feet of depth, but if an opening is excavated in such soil

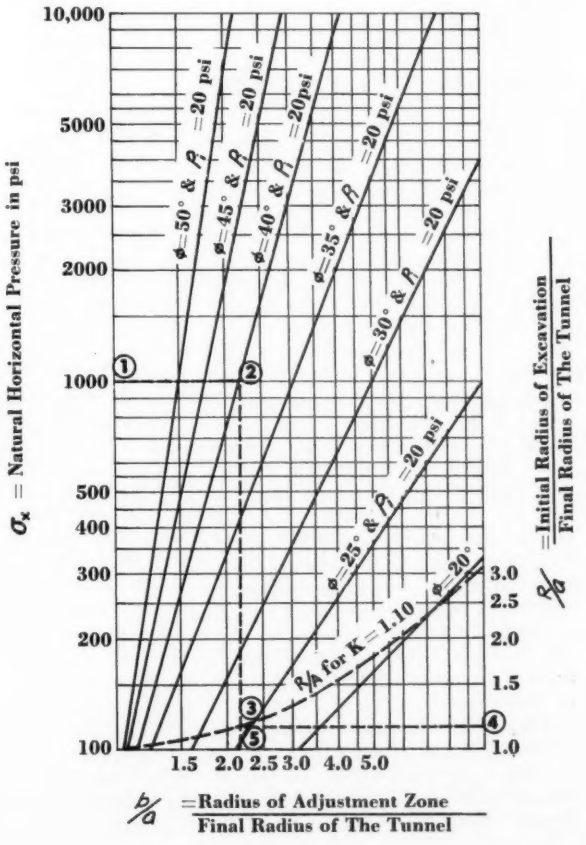


Fig. 7. Graph of the equilibrium equation for various values of the internal friction of the ground. See text for explanation of its use

at a depth exceeding, say, 50 or 100 ft or so, where the pressure exceeds the strength of the clay, then again the ground will squeeze in and tend to crush the supports.

A soft shale may stand well to depths of several hundred feet before the depth pressure exceeds the strength of the rock and causes it to fracture into fragments and to squeeze in around an opening. Many of the shales of the European coal fields are relatively soft and when mining is carried on at depths of 2000 ft or more, the fracturing and squeezing in of the shales makes extensive use of yielding steel arches and rings necessary.

The harder igneous and metamorphic rocks such as granites, quartzites, etc., ordinarily stand well at depths to 10,000 ft. However, at the great depths a ring of fractured rock forms around the perimeter of an opening and in some cases installation of yielding types of support would tend to control the encroachment of this fractured rock into the drift.

In U. S. mines most problems with squeezing ground occur in zones of fault clay or breccia. The broken ground encountered in block caving operations also tends to squeeze and yielding supports are being used in some such operations.

Applications of Yielding Arches and Rings

Figure 6 shows a hypothetical tunnel cross section and the stresses on an element "A" in the ground outside the perimeter of the excavation. From the equilibrium conditions for such an element an equation is derived which expresses the relationship between diameter of the tunnel, the angle of internal friction of the fractured rock, and the radius of the fractured zone.

The amount by which the ground squeezes in is determined by the distance to which adjustments extend into the ground outside the tunnel, and also by the percentage of volume increase which accompanies stress readjustments in the ground. In turn, the distance to which stress readjustments extend into the ground outside the tunnel is determined by the angle of internal friction of the ground, by the external natural ground stress, and by the pressure of tunnel support on the ground.

Figure 7 is a graph of the equilibrium equation for various values of the angle of internal friction of the ground. For an example of its use, assume that the tunnel is driven through a zone of fault breccia at a depth of 1000 ft. The natural ground pressure at this depth may reasonably be assumed to be about 1000 psi, and the angle of internal friction of the fault breccia to be about 40°. Starting at a natural ground stress of 1000 psi in figure 7 (Point 1) we proceed horizontally on the graph to the line representing the angle of internal friction ($\phi = 40°$) at (Point 2). Thence we proceed downward to intersect the R/a curve (Point 3) and thence horizontally to the R/a scale (Point 4) where we see that R/a = 1.15. Thus the initial radius of the excavation must be made 1.15 times larger than the required final radius of the excavation in order to allow for squeeze-in of the yielding supports.

Thus if we need a tunnel with a final clear radius of five ft; that is, a diameter of ten ft, we will have to excavate it to an initial diameter of $10 \times 1.15 = 11.5$ ft to allow the ground to squeeze in while equilibrium is being established.

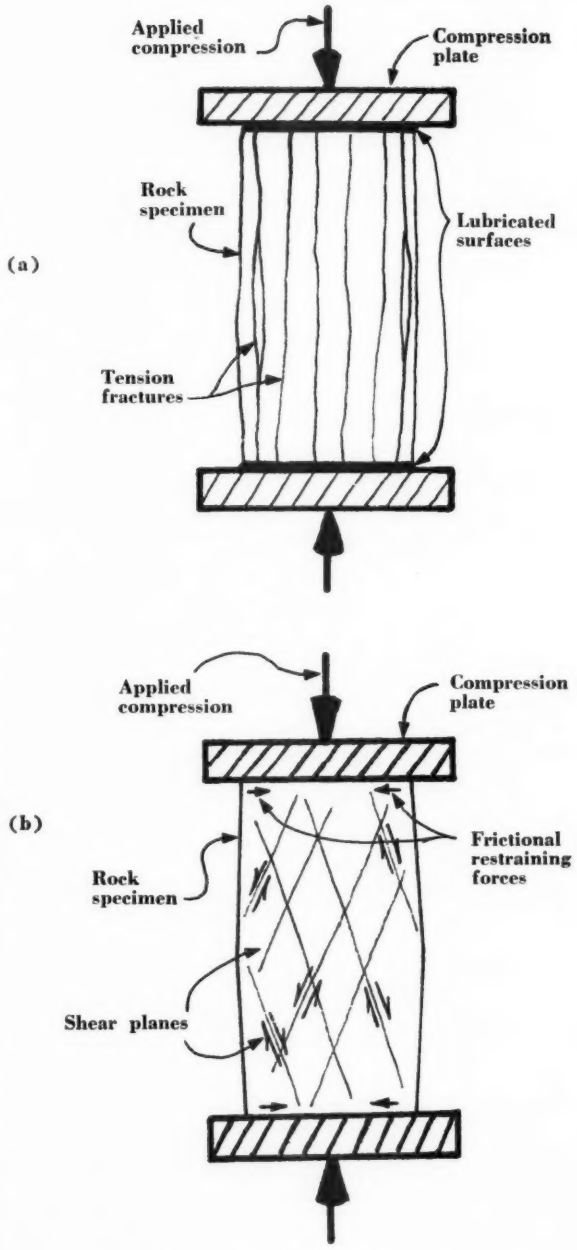


Fig. 8(a) Rock fracture produced by transverse tensile stress induced by compression. (b) Rock fracture produced by shear stress induced by compression

The graphs of figure 7 were drawn on the assumption that the size and spacing of the yielding steel arches would be such as to enable them to support a uniform external radial ground pressure of 20 psi (about 1½ tons per sq ft) all around the periphery of the tunnel.

Rock Bursts Involve Fracturing Along Shear Planes

Figure 8 (a) and (b) illustrate the modes of fracture of rock which is subjected to excessive compressive stress. If a specimen of rock is con-

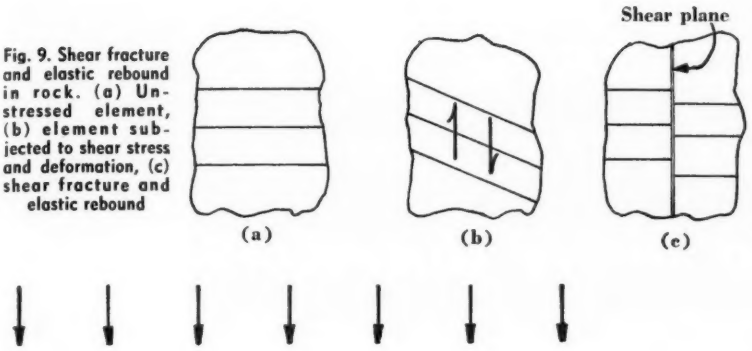


Fig. 9. Shear fracture and elastic rebound in rock. (a) Unstressed element, (b) element subjected to shear stress and deformation, (c) shear fracture and elastic rebound

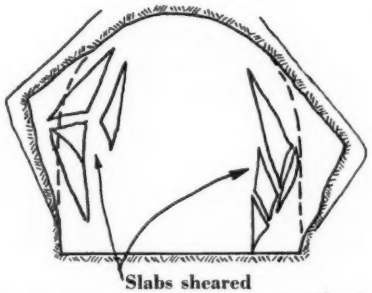


Fig 10. Rock burst. Slabs sheared from the wall of a crosscut due to excessive vertical compressive stress

fined between lubricated compression plates as shown in figure 8 (a) it tends to fracture by separating along planes which are parallel to the direction of the applied compression. This separation is caused by transverse tensile forces which are induced by the applied compression. If a rock specimen is confined between nonlubricated compression plates as shown in figure 8 (b) it tends to fracture along shear planes which are inclined at a small angle to the direction of the compression.

The process of *shear fracture* of a brittle material gives us a clue as to the nature of "rock bursts" and "bumps." Figure 9 shows a small element of rock which is taken from along a shear plane. The element is shown unstressed in figure 9 (a). In figure 9 (b), the element is distorted due to shear stress, and in figure 9 (c) fracture has occurred and the rock on each side of the fracture plane has "snapped back" after fracturing. This action is known as "elastic rebound."

Shear fracture of overstressed rock, with the accompanying "elastic rebound" appears to account for the instantaneous violent release of energy which characterizes rock bursts. Minor energy release such as accompanies "spitting," "popping," or "spalling" of rock flakes and small slabs at the perimeters of openings in brittle rock may be due to fracture by transverse tension.

However the large quantities of energy which are released during the larger rock bursts seem to indicate that relatively large masses of rock are under compression and are released to expand by fracturing along shear planes. Figure 10 shows how slabs may shear from the walls of an opening along intersecting shear planes. Moderately violent rock bursts may occur in this manner, with many tons of rock loosened and projected from the walls of a drift or crosscut.

Occurrences Most Prevalent at Great Depth

Rock bursts have occurred in most of the mining districts of the world where ore or coal is mined at depth, and where roof and floor rocks (or hanging-wall and foot-wall) are of strong brittle rock.

Districts where the rock burst problem has been most serious include the Witwatersrand of South Africa, where the deepest workings extend to depths between 11,000 and 12,000 ft; the mines of the Kolar Gold Field of India, where the deepest workings extend to 10,000 ft, and the coal mines of Springhill, Nova Scotia, where extensive areas were mined out at depths exceeding 4000 ft. For lack of a better name these tremendous rock bursts, occurring usually at the abutments of mined-out areas, have been designated as "pressure bursts." In coal mine terminology such occurrences are termed "bumps" as are also the lesser bursts which accompany spalling or fracture of individual pillars.

Mechanics of a "Pressure Burst"

When a roof supports itself as an intact rock beam, the compressive stress and resultant shear stresses near the ends are relatively small for ordinary beam lengths. If the "beam" contains cross fractures then it derives its strength from "thrust" and compressive stresses near the ends will be very large.

Figure 11 illustrates how a linear arch may rupture by shearing along the direction of maximum effective shear stress. When we consider that such a roof arch may be 50 to 100 ft thick, or more, and several hundred feet long it is evident that a few thousand foot-pounds of energy stored in each cubic foot of rock can add up to several millions of foot-tons of energy released when shear fracturing occurs across the arch. A typical medium-heavy rock burst in the Kolar Gold Field has been estimated to release 15 million foot-tons of elastic energy. This release occurs within a fraction of a second.

Pillar Failure by Bursting

In coal mining a large proportion of the "bumps" are "coal bursts" which result from the fracture of pillars. Such pillars are usually compressed between a strong floor and a strong roof which stands over a wide span without collapsing. Such a pillar is compressed in a manner similar to a specimen of rock crushed in a laboratory testing machine. Coal located a short distance from the free surface of the pillar cannot fracture because it is laterally confined. Any opening advanced into the over-

(*Continued on page 53*)

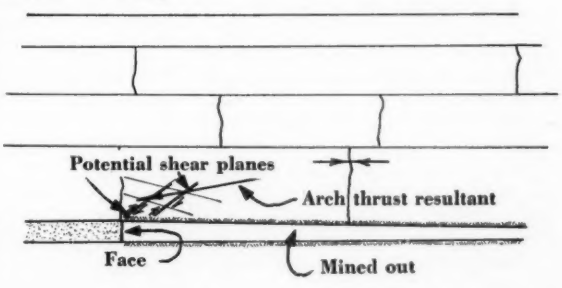


Fig. 11. A "pressure burst." Rupture of a "linear arch" by shear at an abutment

Predicting Performance of Continuous Miner Operators

AMC Committee on Mechanical Mining studies ways to predict performance of continuous mining machine operators

By

Miles Altimus
Harold Durrett
John Osmanski, Subcommittee Chairman

IT has been claimed by informed mining authorities that in the "ole days" of hand loading the difference between a good hand loader and a poor one was about ten tons. Recently experience has recorded that the difference between a good cutter operator and a poor one could amount to as much as 50 tons. Today it is agreed that a good continuous miner operator can excel over a poor operator by as much as 100 tons a shift.

One hundred tons! That's sufficient to warrant some care in the selection of the operator, isn't it?

Furthermore, in most modern sections where continuous miners are being used, the miner operator is the pace setter. All other work is geared to his proficiency, accuracy, efficiency and speed.

Consequently, it becomes important that mine management takes care in the selection of its continuous miner operators.

Still further, some of the findings of the Mining Methods Committee of Bituminous Coal Research, as described in a meeting in Huntington, W. Va., on October 10, 1958, revealed that a boredom factor accounted for some of the faults experienced in the operator's maneuvering of his machine. This led to the suspicion then that certain characteristics like coordination, mechanical aptitude, age, etc., might predict the occurrence of boredom which caused the faulty performance.

To investigate these possibilities and to aid in the selection of continuous miner operators who could obtain the 100 ton differential between good and poor performers, a subcommittee of the Mechanical Mining Committee of the American Mining Congress was directed to launch a study.

This report explains in non-technical language the experimental design of the study, its deficiencies and difficulties as well as the committee's findings.

Factors Considered Include Operator's Height, Weight

The committee suspected on the basis of its own memberships' experience that two hand coordination was a characteristic that might be prerequisite to good handling of a ripper-type machine.

Furthermore, the committee's experience led it to believe that mechanical aptitude or a capacity to learn mechanical concepts might be a factor in the success or failure of a candidate's ability to learn to operate a continuous miner.

From the superintendents of the mines represented by the committee and from practice in selection of operators, the committee also had reason to suspect that the kind of job a new operator had previously held would influence his learning rate and performance as might his years of experience in and about a mine, his age, his experience or length of time running the miner itself as well as his height and weight.

Consequently, it was decided to attempt to correlate with some measure of miner operator performance a number of characteristics. Items selected to compare with a criterion of proficiency are shown below (see "Continuous Miner Selection Study Worksheet").

A general meeting of the Mechanical Mining Committee discussed and agreed on the selection of these items. Intelligence was not accepted as one of these items because of the finding in an earlier study by Harold Durrett of Hanna Coal Co. that revealed the high correlation between it and mechanical comprehension and no correlation between it and the performance criterion.

As a criterion of performance it was decided to use the rating plan that had proved to be reliable in a study by Durrett at the Ireland mine of Hanna Coal Co. Two supervisors of each operator participating in the study were asked to grade each operator's performance in categories like these:

1. Is he typically a very slow worker, a hard worker, a slower than average worker, an average worker, or a very hard worker?

2. Does he usually know his job well, does he know it extremely well,

CONTINUOUS MINER SELECTION STUDY WORKSHEET

Operator Number	Coordination Test	Mechanical Comprehension	Paper Form Board	Age	Height	Weight	Yrs. in School
Dependents	Prior Job	Miles Commuted	Yrs. Operated Cont. Miner	Own Home?		Wear Glasses	Performance Ratings

does he not know it at all, does he know it better than most?

3. Does he usually let up when not watched, does he always loaf when not watched, does he work just as hard when his boss is present as any other time, does he let up a little when his boss is away, or does he work hard when he is not watched?

Several pages of items like these were used but only one was regarded as the criterion group. This item was weighted as shown below and it was the standard against which each other item was compared.

(4) Be pleased to take him
(1) Definitely NOT hire him
(5) Rather have him than most men you know
(2) Take him only if you couldn't get someone better
(3) Consider hiring him

Three Tests Used

Sixty-one operators at Hanna's Ireland Mine, at U. S. Steel Company's Frick Mine, and at Island Creek mines utilizing ripper-type continuous miners were then tested on three tests.

Two Hand Coordination. The Two Hand Coordination Test, sometimes labeled "MOAT" for machine operators aptitude test, is a small machine on which is mounted a disc, in which an elliptical slot is cut. A button is mounted on the slot. A movable pointer, which responds consistently to the turning of two handles, can be moved to any location over the disc. When the machine is turned on by the examiner, the disc rotates one complete revolution in one minute and stops. The button traverses the circumference of the disc and slides back and forth erratically in the elliptical slot. The subject's task is to turn the handles in such directions and at such speeds by simultaneous use of both hands that the pointer will maintain contact with the button. An attached chronoscope registers the amount of time, to 0.01 second, that contact is maintained during each one minute trial.

Instructions concerning the functioning of the machine, containing essentially the information given above and one trial demonstration, are given each subject. The subject then completes ten consecutive trials, his score, rounded to the nearest second for each, being recorded on a score sheet. The mean of the last five trials, rounded to the nearest full second, is used as the subject's score.

Mechanical Comprehension. The Bennett Test of Mechanical Comprehension, Form AA, published by Psychological Corp., purportedly measures the ability to perceive and understand the relationship of physical forces and mechanical elements in practical situations. The difficulty level is suitable for unselected male applicants for industrial jobs and for high school students. Items are presented in terms of simple, frequently encountered mechanisms which do not resemble testbook illustrations or require special knowledge. (Bennett, 1940).

Revised Minnesota Paper Form Board Test, Series AA. Prepared by R. Likert and William Quasha and published by Psychological Corp., the test purports to measure ability to perceive relationships of parts to a whole. Several parts of a geometric figure are shown above five arrangements of similar parts, only one of which is precisely the whole of the given parts. The operator is given 20 minutes to complete as many of 64 items as he can.

Correlations were then run between each item and the performance criterion with these results:

CORRELATION CHART

ITEM	*R with CRITERION*
Coordination Test	+0.208
Mechanical Comprehension Test	+0.101
Paper Form Board Test	+0.153
Age	+0.071
Height	−0.134
Weight	−0.206
Years in school	−0.131
Dependents	+0.162
Mining Experience	+0.019
Years Operating a Miner	+0.106
Miles Commuted	−0.049
Home Ownership	+0.097
Wear Glasses	−0.014

No one item correlates sufficiently positively to predict performance. Several items like the coordination test which has a coefficient of correlation of plus 0.208 and weight which correlates almost identically in a negative direction provide no conclusive predictor but do indicate moderately low relationships worthy of more extensive study in a better controlled experiment.

Deficiencies in the Experimental Controls Noted

Some very obvious shortcomings are evident in the experimental design and the makeup of the group of operators used.

As in most studies of this kind, the derivation of a criterion for measuring performance is the weakest area of the study. In the committee's design, the mean weight of the rating is 3.0. Any normal distribution of ratings should also have such a mean rating.

The average rating given the participants in this study by their supervisors was 3.88, indicating several possible reasons for this moderate skewing:

(1) That supervisors were reluctant to rate their operators low as this might tend to reflect their poor supervision.

(2) That a loyalty halos the relationship between boss and worker and tends to color the rating in a favorable direction.

(3) That a selection process has already taken place and poorer operators have to some degree been eliminated.

Many other possible explanations exist. All would show that there is some reason to suspect the lack of sufficient validity and reliability of the criterion.

Furthermore, the committee had no control over the degree to which an operator applied himself during the testing. An examination of individual responses indicated that the motivation was not constant. Some operators were tested prior to employment and thus were more conscientious, while others were tested after employment and could have taken a "don't care" attitude, thus not showing up well on a given test.

Furthermore, on the coordination test the committee had obviously a select population. The general population average on this test is 31.84 while the average the committee obtained was 38.607, almost a full standard deviation higher. It is suspected that poorly coordinated men had been screened out by some other measure.

Also, the ages of the operators of the committee's group had a narrow span. No operator was over 50 and a bunching of age occurred in the 30 to 35 interval. Thus with no real young or very old operators the sampling may be inadequate.

Similarly the sampling for the item "prior job" was narrow. Operators came from only these different jobs: loading machine operator, shuttle car operator, cutter operator, roof bolter and timberman with two general laborers and one section supply man.

In the same manner the wearing of glasses was not normally distributed. Only eight of the group wore glasses so that no reliable conclusions could be drawn about the wearing of glasses and performance.

Two Hand Coordination Proves Significant

However, despite these obvious deficiencies in the experimental controls, some interesting, perhaps significant, but definitely provocative results were obtained.

On the basis of the correlations made by the Pearson Product Movement Method it can be concluded that:

(a) Mechanical aptitude is not essential to success as a continuous miner operator. Comprehension of or ability to perceive and understand the relationship of physical forces and mechanical elements in practical situations is not related to performance as an operator of a continuous miner. This is surprising when you recognize that a continuous miner is a highly complex piece of machinery. It is, however, not unexpected when you recognize the almost automatic nature of its operation.

(b) The ability to perceive the relationship of parts to a whole or aptitude to perceive spatial relationships is not related to success as a continuous miner operator. This, too, is surprising when you observe the manner in which the operator must relate his operation of the miner to roof, rib and even floor contours.

(c) A very enlightening finding, surprising, too, is the conclusion that success as an operator does not depend on mining experience. Most of us are prone to believe that experience in a mine is prerequisite to success in almost any mining occupation. This study shows that this is an "old wives tale."

(d) Also astounding is the finding that a continuous miner operator relatively soon reaches a level of performance beyond which experience alone does not move him. In other words, after about the first year of operating a miner, the operator does not improve very much. A plateau of performance is reached early, and if that leveling off is not very high, the company had better not keep the operator because he isn't going to improve much after that first year.

(e) Furthermore, this study showed that no relationship of significance exists between job performance on the continuous miner and prior job held. Even considering the limitations of the study, there is sufficient indication to question at least the assumption held in some quarters that only cutter operators or loader operators, for example, can succeed as miner operators.

(f) Again within the known limitations of the study, there is evidence to believe that two hand coordination is related to success as a miner operator, and with this conclusion it can be said that tall operators are better coordinated than heavy operators but that both tall and heavy operators are less desirable than well coordinated operators. In other words, it appears that in selecting operators the physical characteristics are not so important as the two hand coordination ability but that tallness is preferable to heaviness.

(g) No significance was found to length of schooling so far as success as an operator is concerned.

(h) And lastly, it was found that when two hand coordination, height, weight, years of school and number of dependents are considered together, performance can be predicted. In other words, if instead of using any one element by itself to predict success, these five are used on the basis that performance fluctuates relative to variations in two hand coordination, height, weight, years of schooling and number of dependents, then a coefficient of correlation of 0.33 can be obtained which measures the degree of association between performance and these five factors considered together. In other words, this moderately high positive correlation not only measures the relative variations of performance with the multiple elements, but can also be used as a selection formula in predicting what the supervisors' rating of the operators would be. For example:

Performance Rating = 6.189 + 0.024 (Coordination) − 0.039 (Height) − 0.003 (Weight) − 0.025 (School Years) + 0.064 (Dependents)

Example: Case 284

Estimated Rating = 6.189 + 0.024 (30.8) − 0.039 (67) − 0.003 (185) − 0.025 (12) + 0.064 (3)

Or

Perfect Rating = 3.3652
Actual Rating = 3.67
Multiple R = 0.33

In Case 284 where the mine operator was 5 ft 7 in. tall, weighed 185 lb, had 12 years of school and 3 dependents, and obtained a score of 30.8 on the two hand coordination test, it was predicted by this formula that the operator would be rated by his supervisors somewhere between "consider hiring him" and "be pleased to take him" or an average rating of 3.65.

The actual rating was 3.67.

Successful Miner Operator Is Probably Tall, Well Coordinated

Notwithstanding the limited number in this study and the shortcomings of the experimental design, the personnel subcommittee of the Mechanical Mining Committee believes that these findings enthusiastically endorse the need for further research, more company participation and the profitable finding of conclusive evidence that there are factors that can predict miner operator performance. The predictability formula is most significant and useable.

Furthermore, it can be said, by way of summary of these findings, that the typical successful miner operator is not necessarily an old timer in mining, not necessarily a cutter or bolter or loader, not necessarily proficient in perceiving space relations or physical and mechanical concepts, not necessarily a high school graduate, not heavy, but probably tall and probably well coordinated.

With further study of a larger group of operators from more mines, the description could, the committee is certain, be not only enlarged, but made more specific and detailed.

DON'T DO IT

Despite the long-term damage that can result, the practice still persists of quickly starting heavy equipment by connecting it to an electric welder, according to the service department of International Harvester Company's Construction Equipment Division.

Ingenuity here has ignored an important detail — current developed by the electric welders may be as high as 110 volts, while starting voltage on construction equipment units is much less. Although no damage may be evident after one emergency boost by an electric welder, it is certain to manifest itself, in serious form, with additional applications.

Glow plugs have been known to melt because of the powerful welder current, and large numbers of headlights, starting motors, generators, regulators and ammeters have had to be replaced after continued reliance on the electric welder as a starting aid.

The convenience of a quick start can be obtained, in much more practical fashion, by keeping the engine in tune, with a full charge in the batteries. Modern diesels always respond to this treatment.

Maintenance of Continuous Mining Equipment

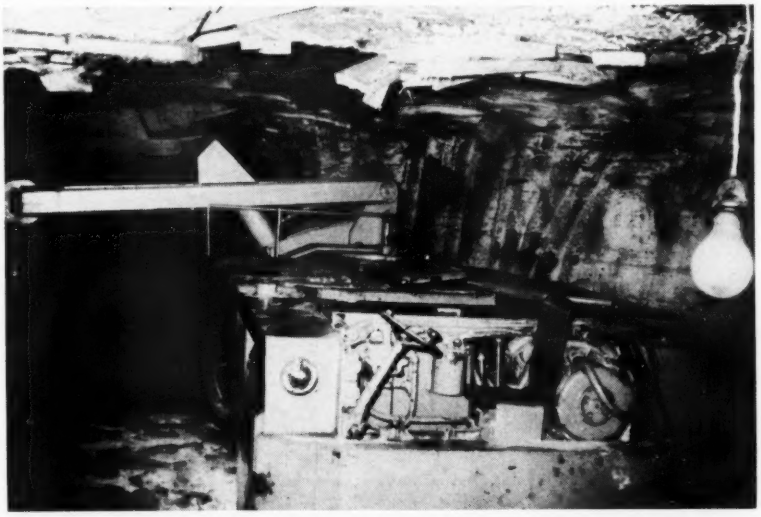
How one mine has doubled its tons per man-shift at the face in the past 3½ years through improved maintenance

By ARTHUR TOWLES
Maintenance Engineer
Bell and Zoller Coal Co.

OPERATING skills, engineering principles and effective maintenance are blended into a smoothly running, efficient operation at Bell and Zoller Coal Company's Zeigler No. 4 mine, Johnston City, Ill. Effectiveness and the technique are proved by an average output of 76 tons of clean coal per man at the Face per shift on pillaring sections. The outstanding performance of production crews did not come about by chance. It is the result of continually applying engineering principles in a program designed to help management do its job more effectively.

Industrial manufacturing plants have led the way in utilization of machine power, and the mining industry must follow suit. Continuous miners have proved that further mechanization is not only possible but profitable. Conveyors have also shown the way to lower costs. These lower costs are not possible, however, without a dependable piece of machinery, and this dependability is governed strictly by a proper maintenance program.

Preventive maintenance, as well as operating techniques, is the key to many of the industry's once costly breakdowns. Many improper operating practices can be charged to lack of knowledge on the part of the operator as to what the machine was designed to do. At Bell and Zoller, there were those foremen who would continue to operate a malfunctioning machine in order to get one more shuttle car of coal when they were actually endangering the machine as well as the production.



Rubber-tired hydraulic boom is a big help when moving and handling heavy parts

Preventive Maintenance—Most Efficient Way to Stop Down Time

In order to compete with other fuels, the coal industry has gone to units where higher production can be achieved, and this has brought about the continuous mining machine. There have been times when the industry wondered why they were called continuous miners because their down time seemed to exceed their mining time; therefore, to achieve a continuous operation, management had to realize the importance of a well organized maintenance program, which includes the following principles:

1. **Operation and maintenance supervisors working together as a team.**
2. **Regular systematic inspections by responsible persons.**
3. **Proper records kept on each piece of equipment.**
4. **Proper lubrication of equipment, thereby helping to eliminate costly down time and replacement parts.**
5. **Preventive maintenance, which is the most efficient way to stop costly down time.**
6. **Provision of proper tools for a particular job.**
7. **Provision of transportation for maintenance crews and parts.**
8. **Properly sharpened bits in the machine at all times.**
9. **Adequate power supply to the machine at all times, thereby preventing many electrical failures.**

As further mechanization is employed in the mines, it is mandatory that an educational program be instituted. Bell and Zoller has adopted a program not only to educate its foremen with the operations of various types of machines, but to include in this program better methods and encourage ideas in the co-ordination of both production and maintenance. A series of reports were initiated along with this program to better facilitate the direction and co-ordination of the working force by the management team.

Program Depends Upon Third Shift Maintenance Crew

The actual maintenance program at Zeigler No. 4 mine depends to a large extent upon the third shift maintenance crew, and in order for this shift to do its job effectively, a pro-

gram is carried out in the following manner.

The unit repairman on each of the two operating shifts completes a daily report of the condition of the machine and any maintenance needed to prevent down time on the operating shifts. This report is given to the chief electrician, who inspects as many units as time will permit, checking the performance of each miner with the operator, repairman and foreman. At the end of the shift the chief electrician compiles the reports, together with his own observations, into an instruction sheet for the third shift chief electrician. The third shift chief electrician, along with carrying out his instructions, sees to it that bits are set on the miner, the feeder cable lengthened or shortened, and the miner, after having been completely serviced, moved back to the face for the operating shift that follows. At the end of his shift, the third shift chief electrician, in turn, completes two reports, one going to the operating shift chief electrician and one to the division office, reporting the work done and by whom it was done.

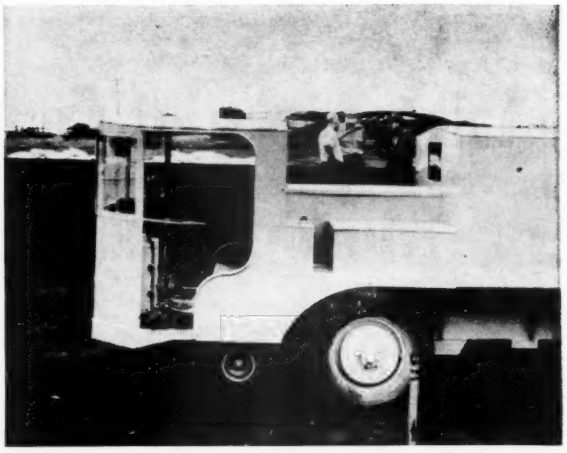
In the mine foremen's quarters on the surface, there is a large blackboard listing every piece of equipment by number, and adequate space is provided for the dates when each motor brush was checked, gear cases serviced and by whom this work was done.

Battery-Powered Jeeps Facilitate Movement of Repairmen

To better facilitate the movement of repairmen, tools and parts, conventional Jeeps have been converted to electromotive power by the use of storage batteries. For convenience in recharging these batteries at any point in the mine, chargers have been made an integral part of the unit. To accommodate the moving and handling of heavy parts, a power wagon with hydraulic boom and electric power as installed on the Jeep has been built and placed in service.

To further improve the mobility of equipment related to maintenance, the 500-kw rectifiers were installed on rubber-tired wagons. This installation has made it possible to move the rectifiers on the third shift without disrupting the previous or following shift's operations.

In conjunction with the mobilizing of underground equipment, conveyor belt drives and belt winders have also been mounted on rubber. The belt winders are self-tramming with ample power to pull tail pieces forward while adding additional belt to the conveyor line.



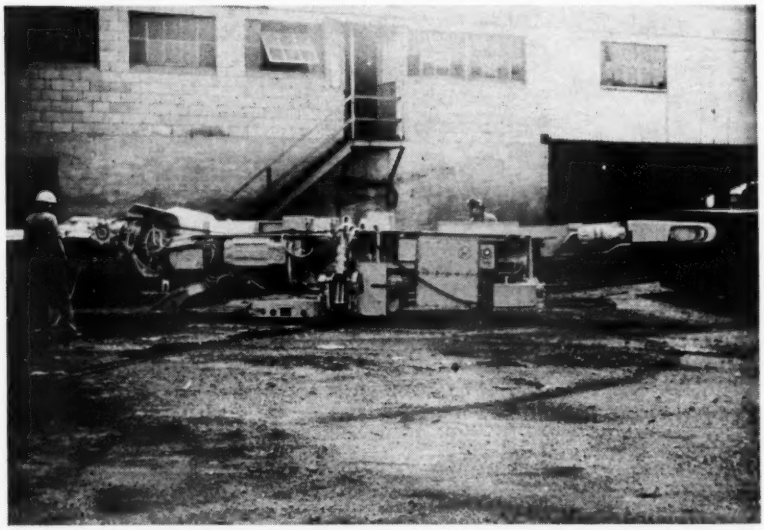
Ziggy Railmobile can travel by rail or road. Four steel wheels (note the one under the cab) are lowered to the rails when this type of transportation is desired

Material for operation and the maintenance program at this mine is loaded in the material yards on top each day onto rubber tired wagons, which are carried by track mounted low-boys. The material wagons are given unit numbers and are sent by rail to their partings where they are pulled from the low-boys and delivered to their respective sections by battery powered Jeeps. Each section is allotted two of these material wagons. When the material deliverer arrives on the section with a load of supplies, he returns the empty to the supply train.

A central shop at Bell and Zoller has proved itself to be a major factor in the eliminating of costly down time by doing major overhauls, incorporating advanced ideas in the improvement of equipment, and building new equipment that has been developed in the company's underground operations. In the central shop, a production line has been initiated, because a large amount of the equipment is completely disassembled, steam cleaned and then returned to the point of reassembly. Trained specialists go over each item carefully before reassembly. As the machines are being reassembled the changes found to be advantageous are instituted in the rebuilding program. It has been the company's goal to standardize many of the replacement parts, thus eliminating a surplus inventory.

Many Changes Made on Miners to Reduce Down Time

All hydraulic lines on the continuous miners have been replaced with pressed-on fittings, male on both ends



Bell & Zoller's central shop has proved to be a major factor in eliminating costly down time. Major overhauls, incorporating advanced ideas to improve the equipment, are made here and new equipment that has been developed in the company's operations is built

Battery-powered Jeeps speed the movement of repairmen, tools and parts underground

with male/female adaptors for connections to pump valve banks, etc.

Hoses, with pipe thread, vary in length from 12 in. up to 72 in. All panel boards for each piece of equipment are built of magnetax contactors —100, 200 or 500 amp capacities.

On the Goodman 400 miners, the company has cut 8 by 10-in. holes on each side of the conveyor at the top of the reservoir and installed permanent magnets in the tank. In the inspection caps, pipe fittings are installed on the right hand side with all return lines dumping over the permanent magnets, while three separate suction lines are provided on the left hand side for the three pumps.

Each 20-gal pump has been provided with a 1¼-in. double braided hose from the tank to each pump. To provide a better way of checking the vacuum on each pump, ⅛-in. fittings are installed in the 90° elbow hose fittings. On the suction side of the pump, no strainers are installed. On each return line off each pump, the company has added Schroeder Model LF-3-K, 35 gpm line filters; also on the return line of the seven-gal pump, the company has installed a large heat exchanger connected through to the reservoir. The pump motor has been installed on the left hand side of the machine just behind the cutting motor. With these changes on the two Goodman 400 miners, very little down time has been encountered over the past 18 months.

On the two Joy continuous miners (1-JCM), the same changes have been made that were made on the Goodman 400 miners. In addition, the company has built on its Joy machines a new 125-gal reservoir in the back of a new bumper, thus doing away with the two separate reservoirs and old bumper.

In order to eliminate long lengths of hose, 2½-in. tubing was installed down both sides of the miner to the manifold. All return lines from roof drills return to the reservoir. To better accommodate the moving of the machine in close quarters, the roof drill controls were moved in so as to be no wider than the machine.

To be more convenient to the operator and roof pinner, the tramming control box was moved on top of the back bumper. To provide ease of inspection and to provide better ventilation, both 15 and 25-hp pump motors were mounted atop of the back bumper, one on each side of the conveyor tail.

Both Joy miners have been raised to provide an additional six in. of ground clearance, and new cleanup devices were installed on the head.

To eliminate much of the dust problems, 12 new water sprays were installed.

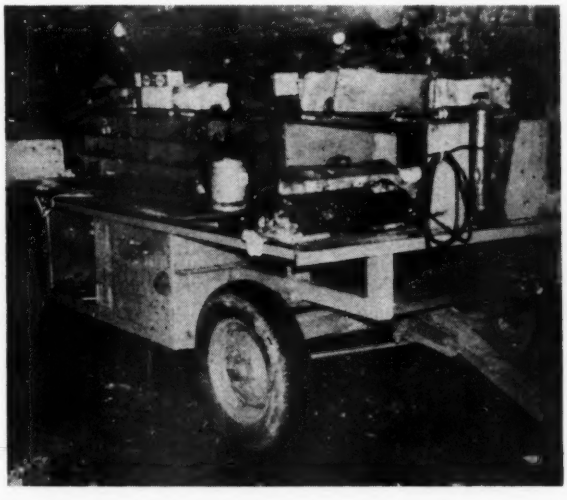
Within the view of the operator on the Goodman machine, the company has installed a recording ammeter, informing the operator of the smoothness of his operating cycle.

To provide ample lighting, four large sealed beam lights with adjustable brackets are mounted on the machines.

All the hydraulic oil that is added to these machines underground is pumped through filters. To facilitate this pumping, a special quick snap coupling to the hose cans is utilized. The hydraulic temperature of the Goodman miner at the end of a two-shift operation is 130°; on the Joy miners, the temperature is 100°.

The hydraulic system on each of these miners has been set up to be used with water emulsion; however, until such time as the oil manufacturers have perfected a suitable product that will eliminate excessive wear to the pump, none will be used. In management's opinion, the continuous miner, with its extensive hydraulic system, has not been provided with sufficient hydraulic storage to permit a flow of oil to the various pumps.

With the aid of the manufacturers and their field men, many changes have been made on continuous mining machines which have cut the company's face down time to a minimum. By the aid of these advanced ideas, an educational program and the coordination of both production and maintenance, Bell and Zoller has attained a smoother operation which has doubled its tons per man at the face in the past 3½ years.



Mobile shop. Providing proper tools for a particular job is an important part of any well organized maintenance program

New Developments in Initiation of Blasts in Mining

A new type of detonating cord is finding application at operations where vibration and noise are serious problems

By H. J. POEL
Manager
Technical Service Section
E. I. du Pont de Nemours & Co.

FROM its very early days, the explosives industry has devoted a substantial portion of its activities to research in an effort to improve its products for the benefit of its customers. The Eastern Laboratory of the Du Pont Co., at Gibbstown, N. J., which was established in 1902, was one of the first industrial laboratories for chemical research in the United States. One of its stated purposes was "to devise or discover new explosives for general and specific purposes." That kind of objective has also motivated the research activities of others in the explosives industry for the last 59 years. From a very modest beginning in 1902, the research activities of the industry have grown to become a major industrial effort.

The customers of the explosive industry have benefited from these efforts. Over the years, both explosives and the accessories used with them have been made far safer and more efficient. This article deals with two recent products of industry's research which illustrate its effort to assist its customers with their problems. One of these is of especial interest to the open pit mining industry—the use of low energy detonating cord in low noise level trunk lines.

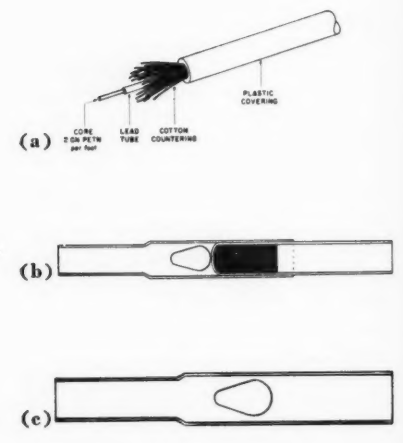


Fig. 1. Components for blasting with low energy detonating cord (a) A2CP LEDC—trunk line which contains two grains of explosives per foot. (b) Trunk line adapter—an empty hollow tube designed to initiate the LEDC at the first hole. (c) Trunk line connector—used to initiate the downline at each hole; available in three periods: 0 milliseconds, 10 milliseconds and 15 milliseconds. (d) DuPont No. 5 Crimper—sometimes referred to as an LEDC cutter crimper, it was designed for the particular job of cutting LEDC and crimping trunk-line connectors and trunk-line adapters to LEDC. No other tool should be used

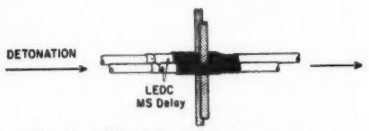


Fig. 2. LEDC-Primacord downline assembly — position ready to tape. If only one downline is used, both connectors are threaded over it

Short Interval Delays Reduce Vibration

The vibration, noise, and air blast created by open pit blasting have been a problem to the mining, construction and quarrying industries probably as long as these industries have been using explosives. As the population of the country increased, people began building houses closer and closer to quarries and open pit mines with the result that vibration and the associated noise problem became more and more acute. There were no really useful tools for dealing with the problem until short interval delay blasting was introduced. The intervals were produced by either delay caps, blast timing devices, or milli-second delay connectors used in

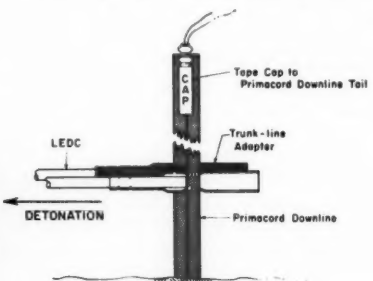


Fig. 3. The initiating assembly at the first hole of a shot consists of one cap taped to the Primacord downline tail, trunk line adapters, and LEDC trunk lines

conjunction with Primacord.

These devices came into widespread use during the five years immediately following World War II, and there is ample evidence to show that they definitely reduce the amount of ground vibration produced by open pit blasting. For example, it is now possible to make a multiple hole shot with little or no more vibration than would be experienced in a single hole blast. Happily, they also improved fragmentation in almost every instance, and in many operations are used for this purpose alone.

It is well known that laymen usually fail to distinguish between ground vibration and air blast, so the best way to keep neighbors from complaining about blasting is to make as little noise as possible. While all of the devices mentioned did reduce the ground vibration from blasting, only one of them, the short interval delay blasting cap, did anything for the noise and air blast part of the problem, and then only when the caps were placed in the bore hole.

Weather Conditions Have Bearing on Complaints

Many operators prefer not to place caps in bore holes for safety reasons, so their only relief from the noise problem was to do one of three things. They could attach the caps to the Primacord down lines at the surface and run the risk of cut-off holes. They could use blast timing devices to minimize the cut-off risk, but these were cumbersome to use. Or they could cover their Primacord trunk lines to reduce the noise level. This was time consuming, and only partially effective.

It was commonly known that when blasting was done during certain weather conditions, such as on rainy days or days with high humidity, there were more complaints than if the same kind of blasting was done on clear days. Naturally, these complaints stemmed from the noise factor even though the complainants didn't necessarily think so.

The New York Trap Rock Corp., over a period of several years, made a study of blasting vibrations, and the noise phenomena associated with blasting. Consultation with meteorologists established that when certain weather conditions prevailed, inversions or isotherms, blasting should not be done if it could possibly be avoided. J. R. Kringel, vice president of New York Trap, reported these findings in an article in the May 1960 issue of *Mining Congress Journal.*

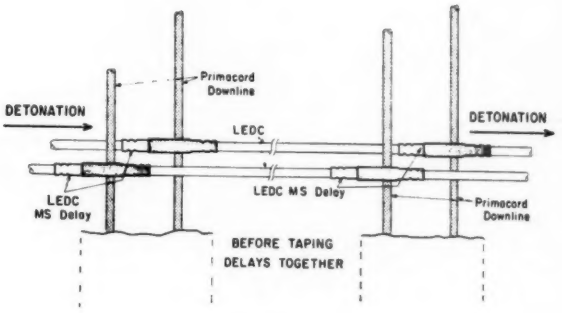


Fig. 4. Method for connecting holes with two downlines

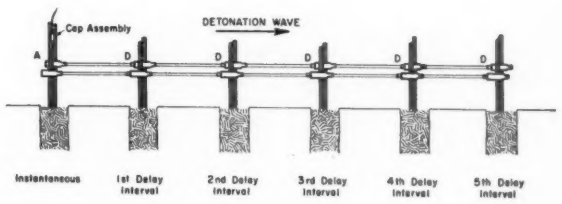


Fig. 5. Arrangement of components in a single row blast

NOTE
"A" Indicates Trunk-Line Adapter
"D" Indicates Trunk-Line Delay Connector
Always assemble with the delay end pointing to the hole where blast is to be initiated.

New Detonating Cord Comparatively Noiseless

Discovery of this phenomenon was extremely useful, but still was not a complete solution to the problem, because at many operations it is not possible to hold off blasting until weather conditions are ideal. At these operations, however, it is now possible to use the new type of detonating cord which contains only two grains of explosives per foot. It is virtually noiseless when compared with ordinary detonating cord, which contains 40 to 60 grains per foot. One hundred fifty ft of low energy detonating cord, or LEDC as it is called, makes about the same amount of noise as one blasting cap or two in. of 50 grain Primacord.

LEDC and the other components necessary to make it work in trunk line systems have only been available for a little over a year. Prior to its being put on the market, it was extensively field tested at several quarries, including some of the New York Trap Rock Corp. It is now being used at a number of operations in the country where air blast and vibration are serious problems. The components shown in figure 1 are necessary to make the system function reliably. Figures 2 to 5 illustrate the details of connecting the system.

Rules for Achieving Maximum Reliability

This system is not as yet adaptable to more than two rows of holes, principally because the delay elements are "one way," and will only shoot in one direction. Two trunk lines should always be used in parallel for insurance against misfire. The maximum reliability of this system depends upon:

(1) Clean sharp cutting of LEDC.

(2) Firm seating of the LEDC in the delay end of the trunk line delay connector.

(3) Firm seating of the Primacord down-line against the base of the delay element in the trunk line delay connector. This is accomplished by pressing the LEDC (which goes to the next hole) firmly against the Primacord down line.

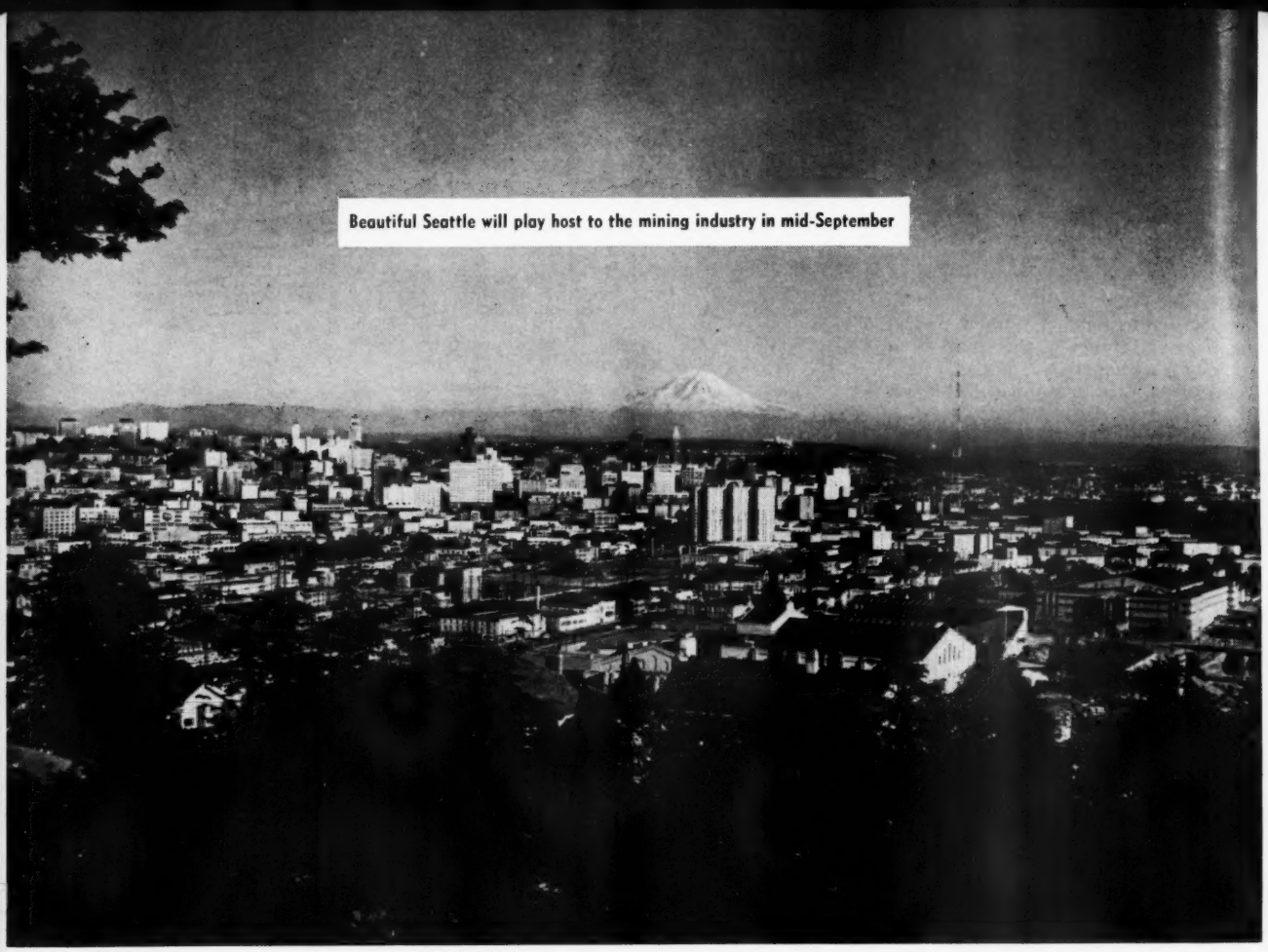
(4) Pointing the delay end of the trunk line connectors toward the hole at which the blast was initiated.

(5) Keeping the cutter-crimper clean and sharp.

It is not yet an ideal system, and research efforts are being directed to improving and simplifying it.

There is another new development for initiating blasts which is primarily of interest in underground mining, but worthy of mention here. For the first time, precisely timed regular delay electric blasting caps are available. All caps of any given period will fire before any cap of the next period, so that there is no overlapping. This new series of caps has given better fragmentation in virtually every operation in which it has been tried and has also provided better control of overbreak in tunnel and drifting rounds.

These two new tools are simply illustrations of how customers of the explosive industry continue to benefit from the extensive research programs that are being carried out.



Beautiful Seattle will play host to the mining industry in mid-September

1961 AMC MINING CONVENTION

Seattle, September 10-13

Trips, September 14

SEATTLE—Queen City of the Pacific Northwest—will be the Mining Capital of the world September 10–13, during the 1961 Metal Mining and Industrial Minerals Convention of the American Mining Congress. Mining men and their ladies from all over North America and from abroad are making plans to attend, and Seattle has already begun preparations for a "red carpet" welcome.

On June 21 State and District Chairmen of the National

Program Committee met with National Committee Chairman Joseph C. Kieffer, Manager, Northwestern Mining Department, American Smelting & Refining Co., to develop a Convention program that will cover thoroughly the wide range of subjects having impact on the industry at this time. These include national policy as well as the newest developments in mining technology.

Members of Congress and high Government officials who are cognizant of the industry's problems will be on hand to take part in the sessions involving legislative and administrative policy. Industry leaders will join in these discusions and will outline the problems confronting various branches of the industry. Every important area of mining technology—from exploration to beneficiation and safety—will receive concentrated attention by qualified operating and technical men.

A number of special functions of interests to mining men and ladies have been planned, beginning with a general reception and cocktail party on Sunday, September 10. On Monday there is the Welcoming Luncheon and the traditional Miners' Jamboree, this year taking the form of a "Potlatch" Celebration. Fishermen will want to take in the Salmon Derby which is planned for both Tuesday and Wednesday mornings. Highlight of Convention week will be the customary Speechless Banquet Wednesday evening.

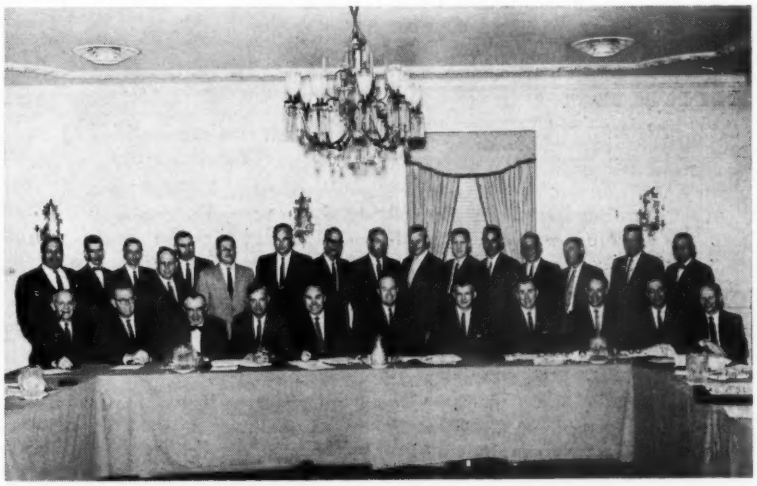
A variety of delightful activities have been arranged for the ladies—including a Flower Arrangement Luncheon on Tuesday and a Brunch and Boat Trip on Wednesday. Featured at the luncheon will be a nationally famous floral designer. Wednesday's event will include luncheon at the Wharf Restaurant, a scenic cruise of Seattle's landlocked waters, and a sight-seeing trip enroute back to the hotels.

The week's activities will wind up Thursday, September 14, with four specially arranged trips. An all-day excursion to Victoria, British Columbia's lovely capital city, will be of interest to many. Another group will take in the fall wonders of Mount Rainier National Park. Still others will visit Bethlehem Steel Company's modern Seattle plant or tour the Boeing Airplane Company's Transport Division at nearby Renton.

Empress Hotel and harbor of Victoria, B. C.

An enthusiastic group of Seattle committee members have been working under the leadership of AMC Western Division Chairman Robert M. Hardy, Jr., President, Sunshine Mining Co., and Arrangements Committee Co-Chairman S. M. Strohecker, Jr., Seattle manager of E. I. du Pont de Nemours & Co., Inc., in developing plans that will assure a memorable visit to the Pacific Northwest.

Plan now to attend—you owe it to yourself, and the industry will be better off because you did. Immediate travel and hotel reservations are suggested; requests for hotel accommodations should be addressed by air mail to AMC Housing Bureau, c/o Seattle Convention & Tourist Bureau, 215 Columbia St., Seattle 4, Washington, advising arrival and departure times and type of rooms desired.



Mining leaders met in Seattle June 21 to map out the convention program

Economics of *Truck* Vs. *Belt Haulage*

Experience at both U. S. Borax and Riverside Cement led to the conclusion that elevating ore to the processing plants could best be achieved with belt conveyors

By D. M. COOPER
Senior Mining Engineer
United States Borax & Chemical Corp.
and
P. B. NALLE
Superintendent of Mining
Riverside Cement Co.

SIX years ago, United States Borax & Chemical Corp. reached a decision to convert its Boron, Calif., mines from underground room-and-pillar operations to an open pit system. As might well be expected, that decision triggered a formidable array of problems, all of which have either been successfully resolved or are now well on the way to satisfactory resolution. This article deals with one of these problems; the economics of transporting ore from the pit to the surface.

After a detailed study of several haulage techniques was made, the final analysis revealed that the economics of removing ore from the open pit boiled down to this alternative; truck haulage vs. belt haulage. Further studies revealed that both systems could be economically adopted; trucks during the initial phase and a belt system when the pit had been sufficiently developed to allow a permanent installation.

Hindsight shows that this was the right decision for several reasons. A considerable amount of incompetent shales had to be tunneled through, major structure had to be crossed, and the crusher station had to be placed in the ore. Postponement of the belt haulage project allowed the crusher station to be located in the footwall of the ore body.

Belt Haulage Justified By Detailed Study

From the beginning, and after studying several alternate methods, it was decided that the most favorable time to place the belt conveyor and crusher station in the pit was three years. Now four years have passed and the belt conveyor and primary crusher have been installed and are in operation.

In order to justify the installation of a belt conveyor and a new primary crusher, a detailed study was made of the truck haulage system versus the proposed belt haulage system. The first order of business in the investigation called for a detailed layout of the crusher station in the pit and location of a 42-in. conveyor on an 18° slope. As a result, the stacker belt was to be lengthened 120 ft.

After the mine department chose a definite layout, the plans and sections were forwarded to the company's Los Angeles Engineering Department where definitive plans for a crusher installation, belt layout, and belt extensions were made. In cooperation with the Los Angeles Engineering and Boron Mining Departments, manufacturers submitted quotations on component parts of the crusher and conveyor belt installation. From the manufacturers' current quotations a capital cost and replacement schedule for the project was obtained.

In the meantime, the mine department at Boron, after obtaining estimated ore requirements for a 15-year period, laid out in detail an ore mining scheme for that period of time. From the calculated cycle times and truck requirements, a detailed equipment schedule was made for both competitive methods.

Truck Cycle Time Cut in Half

It becomes readily apparent, after examining both total truck cycle times, that the belt conveyor on the adverse grade reduces the truck cycle time by a factor of two (See table 1). Additional benefits are available from the new 54-in. by 70-in. hammermill,

TABLE 1. Truck cycle time for current truck system vs. proposed conveyor-truck system

Fiscal Year Ending	Difference in Elevation	Adverse Grade Distance	Total Cycle Time	Ratio of Trucks Required
1961	150– 70	2150–1000	17.90– 8.29	1.00–0.43
1962	200–120	2860–1710	19.16– 9.56	1.07–0.50
1963	230–150	3300–2142	19.95–10.32	1.14–0.64
1964	270–190	3860–2710	20.93–11.34	1.28–0.72
1965		↑	21.33–12.03	1.43–0.86
1966		|	21.80–12.78	1.57–0.93
1967		Interpolated	22.22–13.44	1.71–1.07
1968		|	22.73–13.96	1.93–1.21
1969		|	23.19–14.26	2.07–1.29
1970		↓	23.67–14.54	2.28–1.43
1971	400–320	5710–4570	24.23–14.65	2.50–1.57
1972		↑	23.12–13.91	2.57–1.57
1973		Interpolated	22.16–13.20	2.64–1.57
1974		↓	21.28–12.50	2.78–1.64
1975	250–170	3570–2428	20.42–11.79	2.86–1.64

In each column, figures on the left of the hyphen pertain to the current truck system, and the figures on the right of the hyphen, to the proposed truck and conveyor system. See table 2 for explanation of truck requirements.

TABLE 2. Operating schedule, current truck system vs. proposed conveyor system*

Fiscal Year Ending	Supervision Ratio	Shovel Ratio	Truck Ratio	Tractor Ratio	Water Truck Ratio	Grader Ratio	Crusher Ratio
1961	1.0–0.5	1.0–1.0	1.00–0.43	1.0–0.7	1.0–0.5	1.0–0.5	1.0–0.5
1962	"	"	1.07–0.50	"	"	"	"
1963	"	"	1.14–0.64	"	"	"	"
1964	"	"	1.29–0.72	"	"	"	"
1965	"	"	1.43–0.86	"	"	"	"
1966	1.0–1.0	1.3–1.3	1.57–0.93	1.3–1.3	1.5–1.0	1.5–1.0	1.0–1.0
1967	"	"	1.72–1.07	"	"	"	"
1968	"	"	1.93–1.21	"	"	"	"
1969	"	"	2.07–1.29	"	"	"	"
1970	"	"	2.29–1.43	"	1.5–1.5	1.5–1.5	"
1971	1.5–1.0	1.7–1.7	2.72–1.57	2.0–1.3	2.5–1.5	2.5–1.5	1.5–1.0
1972	"	"	2.79–1.57	"	"	"	"
1973	"	"	2.86–1.57	"	"	"	"
1974	"	"	2.93–1.64	"	"	"	"
1975	"	"	3.00–1.64	"	"	"	"

* The base is equal to one and the current fiscal year (60–61) equipment requirements are also equal to one. In each column, the figures on the left of the hyphen pertain to the current truck system, figures on the right pertain to the proposed truck and conveyor system.

whereby the crushing capacity is increased approximately 85 percent. This increased capacity allows a more efficient scheduling of facilities. This is best illustrated in table 2.

Table 2 shows an operating advantage for the conveyor method for the first and last 5-year periods. The crusher, supervision and auxiliary equipment (tractor, water truck and grader) do not require extra shifts to meet production demands.

For ease of understanding and reference, table 2 is designed so that all figures are a ratio to present practice by setting equipment requirements to unity, or one. Also, a ready comparison is available by placing the annual equipment requirements for both methods in columns separated by a dash.

Using the basic scheduling data and the equipment and labor charging rates, operating costs for the two schemes were determined. A comparison of these operating costs over the 15-year period showed a substantial savings in favor of the belt conveyor system (figure 1). Likewise, for the same period, depreciation schedules were made and, again, a substantial saving is realized in belt conveyor haulage. Capital costs for the two competitive systems over the given period are close. However, 60 percent of the capital cost in the conveyor system is for acquisition and replacement of new trucks and 40 percent is for the installation and replacement of the conveyor and crusher.

Twenty Percent Return on Investment

The summaries of the operating, depreciation and capital costs were placed in a profitability index which is merely a method or formula whereby the return derived from a capital investment is mathematically determined. In this way a calculation was made to determine the net rate of return after taxes. Over the 15-year period, the savings produce a return on the investment in the range of 20 percent.

Not to be overlooked when considering the advantages of one system versus the other is the safety factor. Belt haulage materially reduces manhours of exposure, particularly in the operation of trucks on adverse grades. The possibility of a truck and its operator plummeting over the steep embankment is virtually eliminated.

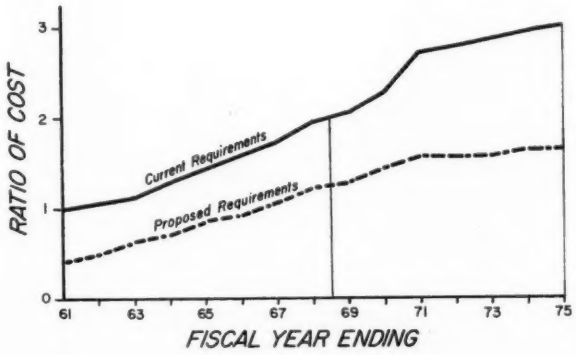


Fig. 1. Cost of current truck requirements vs. belt conveyor on adverse grade with trucks

Conveyor Installation Compared with Trucks at Crestmore

A striking parallel can be seen between the experience and planning of U. S. Borax and that of Riverside Cement Co. at its Crestmore mine. Riverside started production from the new room and pillar mine in 1955. Limestone was hauled from the first level 330 ft up to the primary crusher by electric-powered trucks. These trucks hauled a 25-ton load up a 10 percent grade at 10 or 12 mph.

At the time mining operations were planned, it was realized that the haulage system would have to be modified in order to maintain production from deeper levels. Much experience has been gained and cost data have been accumulated during the past five years of operation with the trucks.

Time studies of present operations enable us to predict production capabilities of the haulage system from future levels and the additional units required by the system to maintain production. A careful study of the ore body and future plant requirements has allowed us to make a time schedule as to when each successive level will be worked out. By combining the information from the time studies and the planning a cost curve can be made giving future haulage

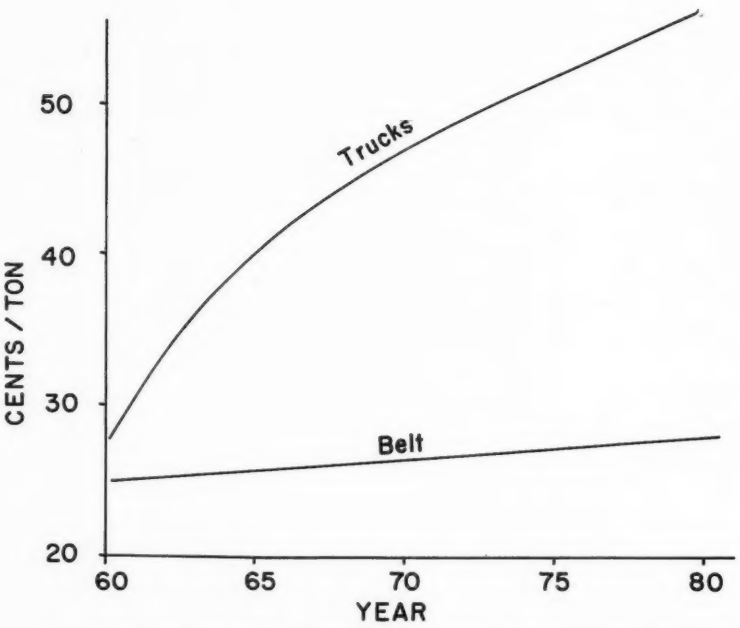


Fig. 2. Haulage costs at the Crestmore mine were projected by combining information on mine development plans, future processing plant requirements, and time studies of present operations

costs (See figure 2). Table 3 gives some of the basic information used in calculating the curves of figure 2.

TABLE 3. Summary of time study figures

Load and dump time	5.5 min.
Travel up grade	5.67 min. per mile
Travel down grade	5.24 min. per mile
Level haulage in stopes	5.80 min. per mile
Truck capacity	25 tons
Hours operated per shift	7
All haul roads on	10 percent grade

Preliminary Studies Involved Four Systems

It can be seen that, as the mine goes deeper, the haulage costs will get very far out of line. In searching for the lowest cost haulage system, preliminary studies were made for the following systems:

Underground crusher and belt to surface, using present trucks to haul to crusher.

Underground crusher and high speed electric bottom dump trucks and trailers to haul crushed rock to the surface.

Skip hoist in incline shaft.

Vertical shaft and hoist.

A belt and underground crusher turned out to be the best of the four methods when operating cost, flexibility, capability of expansion, and capital expense requirements were all considered. A comparison curve for the belt system cost is shown on the truck cost curve in figure 2. These curves are drawn to show the total cost per ton at the predicted production rate for the year.

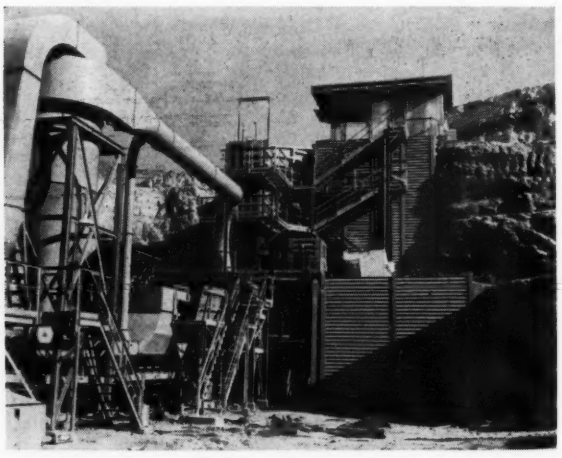
Table 4 is a comparison of capital charges required by the present system and the belt system over the next ten years. The actual raise for the belt would be required whether the belt were installed or not, inasmuch, as a second exit for the mine is required by law.

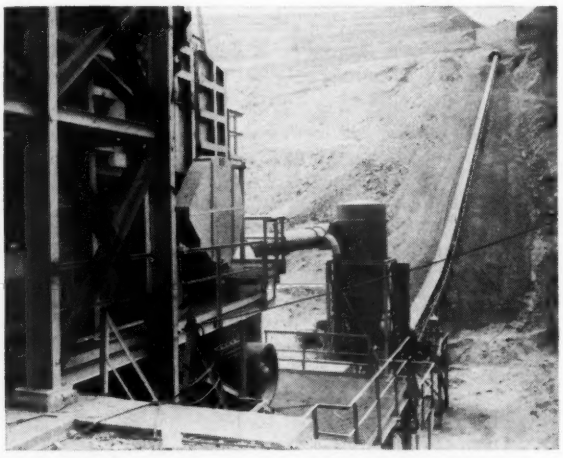
TABLE 4. Comparison of major capital expenditures

BELT & TRUCKS		*TRUCKS ALONE*	
Belt	$200,000	4 trucks	$260,000
Crusher	200,000	2 rectifiers	90,000
Misc. facilities power, etc.	100,000	Additional trolley system, road surfacing, etc.	20,000
TOTAL	$500,000	TOTAL	$370,000

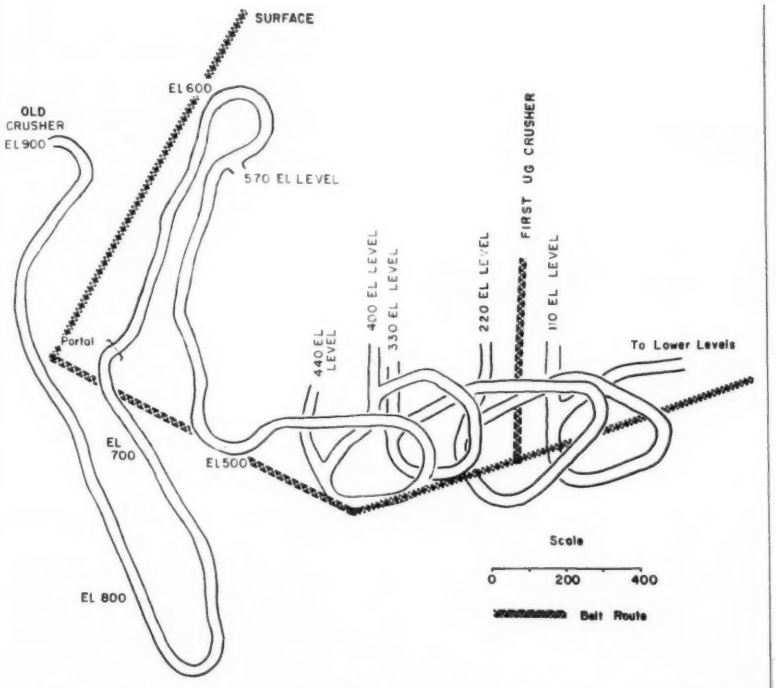
An evaluation of the present system versus the proposed system by the discounted cash flow technique gives a return on the investment of about 15 percent with a payout of six years.

The belt will be installed in four flights on an 18° slope in order to get through the caved area and old mine workings. Total lift will be 740 ft. Tons per hour will be 400 average, 550 peak. The third flight will be arranged so that it can be extended





(Left) The crusher station at the Boron open pit is in ore at the bottom of the mine. (Right) The new conveyor belt transports as much ore in three hours as the truck fleet did in eight



Haulage road at the Crestmore mine showing the proposed belt route and location of the underground crusher

down dip at a future date.

Development has been and will continue to be planned in order that long, straight belt runs will be possible.

The exact interval at which the crusher should be moved and the belt extended will be the next phase of the study. Operating expense with the first phase will give information that will make precise analysis possible.

Preliminary study indicates that three or four levels can be mined and hauled to the crusher by electric truck haulage. This represents an elevation difference of 330 or 440 ft, which can be readily handled by the electric truck system without an undue increase in labor and truck force.

TABLE 5. Tonnage production and requirements

PRODUCTION REQUIREMENTS	
Present	70,000 tons per month
Future	100,000 tons per month
APPROXIMATE PRODUCTION PER TRUCK PER SHIFT	
From 330 level	500 tons
From −40 level	300 tons

Similarity Between Boron and Crestmore Plans

As mentioned, there is a strong parallel between the experience and planning at U. S. Borax and at Riverside Cement. Both companies started out with an ore body of considerable extent, located well below the elevation of the processing plant. Both companies utilized off-highway trucks on steep grades to open the deposit, even though they realized that ultimately some other transportation system would be required.

The flexibility and maneuverability of truck haulage in the early phase of mining gave both companies the time and information required to design the most appropriate haulage system for continued mining.

In both cases trucks will continue to play an important part in the mining planning. However, the vertical lift by trucks will be minimized and the brunt of the elevating ore will be taken by conveyor belts set at the maximum slope possible. It is interesting to note also that both companies have designed belt flights which, 15 or 20 years ago, would have been impossible because of the belt tension requirements.

The studies of both companies have indicated substantial ultimate savings by utilizing belts for elevating ore. In addition "fringe benefits" include increased safety, less maintenance headaches involving rolling stock, fewer personnel, ease of increasing or curtailing production, etc. This saving will not be made without the expense of additional capital requirements; but in each case, when analyzed, a reasonable return on the investment has been indicated.

Developments in Autogenous Grinding

Interest in the use of screened ore as grinding media has been particularly high in Canada

By BUNTING S. CROCKER
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AUTOGENOUS grinding or pebble grinding is not new, but the current mills are so different from the early pebble grinding plants at the start of the century that few old-timers would recognize those of today. These modern mills are almost fully automatic and the efficiency is equal to that of ball milling. Development of autogenous grinding has gone along three main lines: Dry primary grinding, wet primary grinding and secondary pebble grinding.

Dry primary grinding—Fully autogenous grinding in which run-of-mine ore is ground dry to process fineness in one large diameter mill in one step.

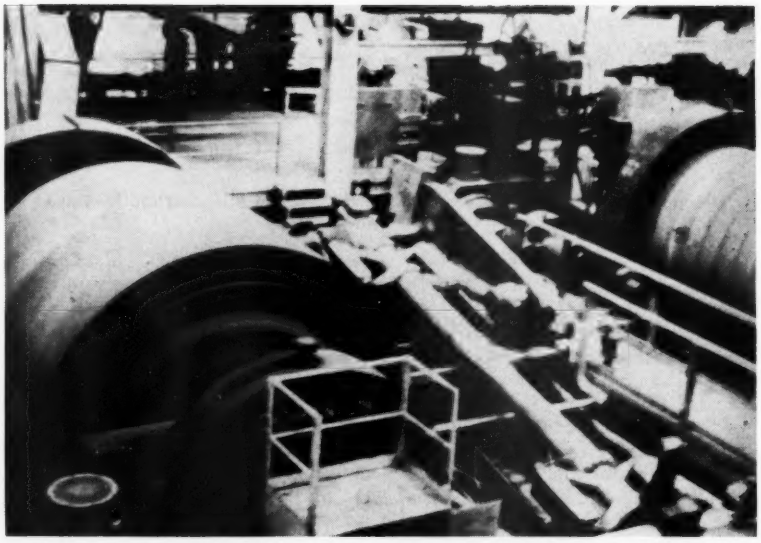
Wet primary grinding—Fully autogenous grinding in which run-of-mine ore is ground wet to process fineness in one large diameter mill in one step, or in two steps using secondary pebble milling as the second step.

Secondary pebble milling—Fine grinding in pebble mills in which the ore is first reduced to about 6 to 14 mesh by conventional means. This step is always done wet.

Although much of the information on the development of the above types of grinding has already been published it might be well to briefly review their growth.

Recent Conversions Include 800-HP Mills

The modern concept of wet pebble milling was revived on this Continent by Lake Shore Mines at Kirkland Lake, Ontario, in 1949. At this time 5 ft by 16 ft tube mills with steel balls were converted into 6 ft 8 in. by 16 ft pebble mills using screened ore as the grinding media. A similar conversion was made at the Wright-Hargreaves plant in 1950. In 1956 the Neptune plant in Nicaragua was also converted with the secondary grinding using screened ore.



Shown at left is one of four 9 by 10-ft ball mills at the Algom Quirk mill, which were converted to 12 by 10 ft grate discharge pebble mills by attaching an expanded shell to the original end

In the period 1956–58 four new uranium plants were built in which the secondary grinding was all done with screened ore. These were Bicroft, Faraday, and Dyno in the Bancroft area, and North Rankin Nickel Mines in the Northwest Territories. These were all new plants which were designed to incorporate pebble milling as the means of grinding from 6 to 200 mesh. In 1957–58 the Renabie mine was expanded and converted to pebble milling. All the above plants were described by this writer in the paper, "Recent Developments in Pebble Milling," which was presented at the Rocky Mountain Minerals Conference in 1958.[1-7]

Pebble milling received a big boost in 1959 when four new and large concentrators in the Elliott Lake area of Ontario converated their secondary ball mills to pebble mills. Three of these plants were milling 3000 to 3500 tpd and the other between 6000 and 7000 tons, a total of over 15,000 tpd. Some of the units were the largest to date in Canada—800 hp. Mills of this horsepower are used also in South Africa.

These conversions cost between a quarter and a half million dollars, but with steel and chemical savings, the users were able to repay the cost in from 10 to 16 months. The flexibility of pebble grinding was demonstrated, when for economic reasons, eight of the grinding units were expanded from 9 to 12 ft in diameter,

TABLE 1. Pebble mill installations

A. *New Plants* Mine	Location	Year Started	Daily Tonnage	Number and Size[1] of Pebble Mill	Manufacturer	H.P. Per Mill	Total H.P.
1. Bicroft	Ont.	1956	1200	2—9′ × 11′	Hardinge	270	540
2. Faraday	Ont.	1957	1400	2—9′ × 11′	Hardinge	270	540
3. North Rankin	N.W.T.	1957	300	1—9′ × 11′	Hardinge	200	200
4. Dyno	Ont.	1958	1000	2—9′ × 11′	Canadian Allis Chalmers	270	540
			3900				1820

B. *Conversions* Mine	Location	Year Started	Daily Tonnage	Number and Size[1] of Orig. Pebble Mill	Manufacturer	Size[1] of Converted Pebble Mill	Installed H.P. Per Mill	Installed Total H.P.
1. Lake Shore	Ont.	1949	1000	8—5′ × 16′	Canadian Allis Chalmers	8—6′8″ × 16′	175	1400
2. Wright Hargreaves	Ont.	1950	500	4—5′ × 16′	Canadian Allis Chalmers & Dominion	4—6′8″ × 16′	175	700
3. Neptune	C.A.	1956	720	?		1—5′ × 10′ 1—6′ × 10′ 7′ × 15′	284	284
4. Renabie[2]	Ont.	1957–58	550	1—8′ × 10′	Dominion	1—10′ × 10′[2]	300 250	550
5. Algom Quirk	Ont.	1959	3000	4—9′ × 10′	Dominion	4—12′ × 10′	400	1600
6. Algom Nordic	Ont.	1959	3000	4—9′ × 10′	Dominion	4—12′ × 10′	400	1600
7. Denison	Ont.	1959–60	6000	4—10½′ × 13′	Dominion	4—10½′ × 24′	800	3200
8. Milliken	Ont.	1960	3000	2—10½′ × 13′	Dominion	2—10½′ × 25′	800	1600
			17,770					9,334
Overall Total A & B			21,670					10,154

[1] *Refers to inside steel diameter of the shell and the length.*
[2] *Also one rod mill and one 9′ × 11′ Pebble Mill added to convert and increase tonnage.*

and six of the 10½-ft diam mills were lengthened from 13 to 24 and 25 ft. All are operating satisfactorily. They are not sizes that would have normally been chosen for a new plant.

Major Shutdown not Necessary

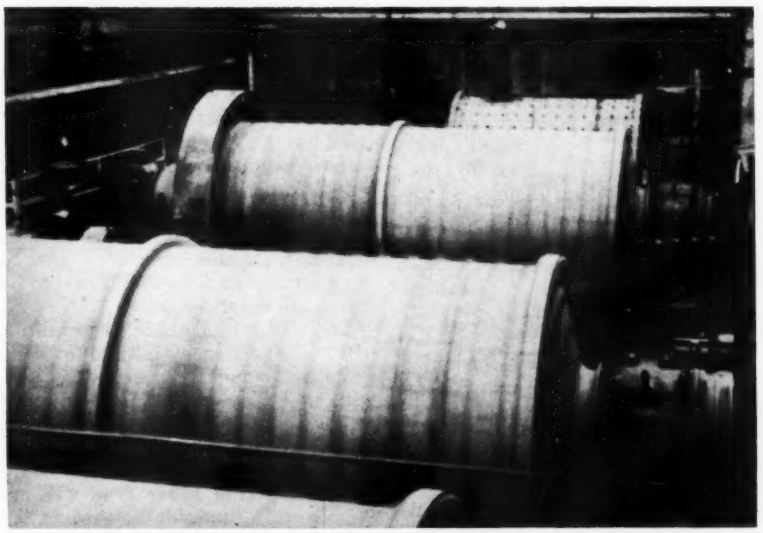
Screened rock from the crusher plants was tested first in a mill at the University of Toronto by the writer to determine the suitability of the ore to produce grinding pebbles.

As might be expected there are many more design problems connected with a conversion than there is with an original design. It is also necessary to make the changeover without a major shutdown.

Liner design and grate design are important as they differ slightly from that used in ball milling, and most operators have been trained along ball milling lines.

Some of the pertinent data in these conversions and the new plants are given in Table 1.

In the last few years pebble grinding has been added to Climax Molybdenum Company's cleaner flotation circuit at Climax, Colo. Three stages of pebble milling are used to regrind the rougher concentrate to give the finished concentrate. They are using three 6 ft 8 in. by 20 ft Marcy grate discharge mills running at 25.5 rpm for the first regrind. Two 8 ft by 20 ft Marcy grate mills operating at 21.5 rpm are used for the second regrind and two identical mills for the final regrind. All units are using 200-hp motors. The mills are charged with flint pebbles obtained from France and Denmark. The maximum size of pebble is three ft.



Three 10½ by 13-ft ball mills at Denison Mines were lengthened 11 ft and converted to pebble mills. These are 800-hp units, and among the largest in Canada. Workmen in background are converting the fourth mill

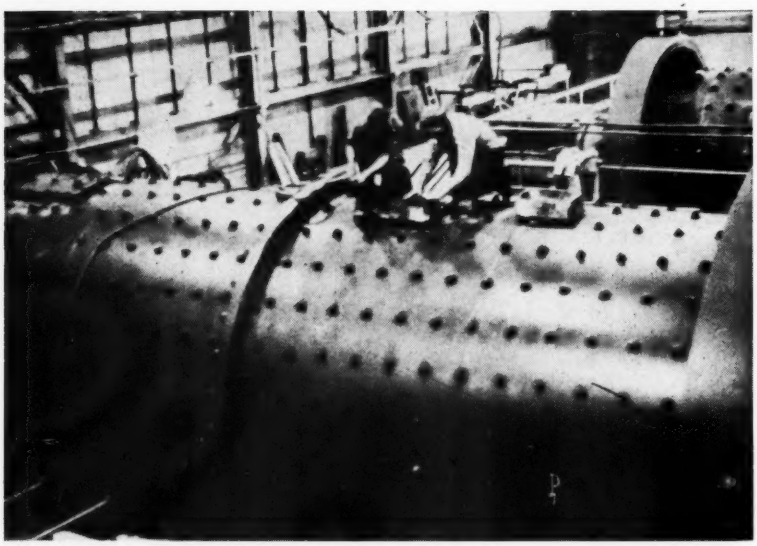
First Autogenous Grinding in U. S. in 1908

An excellent review of all autogenous grinding and particularly wet and dry primary grinding was given by Harlowe Hardinge at the 1958 American Mining Congress Mining Show. He pointed out that the first use of rock in the United States to grind itself was reported in 1908.[8] He traced the development of the Hadsel mill and commented that these early mills lacked the automatic control devices that are available today and which have greatly improved operation.

The dry primary grinding Aerofall mill was discussed by D. Weston at the International Mineral Processing Congress in April 1960.[9] Weston has published many articles on his dry grinding Aerofall mill.

Find that Pebble Milling is the Most Economical

At the 1959 AIME Annual Meeting the author delivered Dr. O. A. E. Jackson's paper on pebble milling practice at the Union Corporation's six mills in South Africa.[10] These plants are typical of other mills on the Rand. It is particularly interesting to note that in these six plants, with daily tonnages from 2840 to



An 11-ft section was connected to the original 13-ft shell by means of a flanged joint as part of the conversion of Denison Mines' ball mills to pebble mills. The plant has a capacity of 6000 tpd

7830, and a total daily tonnage of 27,590, they are using a total of 105 grinding mills. Of these 98 are pebble mills. Many plants use three stages of pebble milling in grinding from 95 percent minus 3/8 in. to about 80 percent minus 200 mesh.

The primary pebble is six to seven in. in diameter and weighs about 12½ lb. The secondary pebble is 3 to 3½ in. and weighs about two lb, and the tertiary pebble is 1½ to 2 in. and weighs about ½ lb.

Union Corp. found that rod mills were more economical than ball mills for the primary stage of grinding and that pebble mills were more economical than either. They are particularly pleased with the operation of their new 12 by 16 ft pebble mill with 800-hp motors on the drive.

Pebble Loads Adjusted Automatically

A means of automatically controlling the pebble load to give maximum power was designed by J. E. Williamson and has been very successful.[11]

Williamson's device, which senses the first differential of power consumed by a mill, cyclically, controls the mean rate of addition of pebbles to maintain the power consumed at all times very close to its maximum. This maximum will vary with the quantity and quality of both the new feed and the circulating load, and the moisture content of the mill. It is remarkably effective and operating data have shown that a mean increase of approximately 40 hp, or 4½ percent for a 12 by 16-ft pebble mill, may be achieved over that obtained by personal judgment of pebble addition.

Dr Jackson's concluding remarks contain this paragraph:

"Steady progress in its development in South Africa over half a century has brought the practice of pebble milling to its present state of efficiency establishing that, for its gold ores, the use of pebbles as grinding media is considerably more economic than the addition of either steel balls or rods. Furthermore, the cost of producing suitable pebbles is unlikely to advance as fast as the price of steel grinding media. Whilst steel is sometimes employed in all the primary milling stage, recent experience has shown that, in nearly all cases, it could be eliminated by the preparation of finer mill feed."

The writer would like to take this opportunity to apologize to the South African milling industry for the reference in a previous paper to feeding pebbles into the mills from a wheelbarrow by native labor. Seven letters were received from South Africa pointing out this practice has long since been obsolete. Pebbles are fed now from ore trucks, conveyor belts, etc., in a mechanical manner. There was no intention to cast aspersions on the practice in South Africa where pebble milling originated.

Ore Suitability Test Devised

Interest in pebble milling has developed to such a point in Canada that in the past year every new mining venture, which has been even thinking of building a mill, has at least considered the use of ore pebbles to do their grinding.

To determine that any given ore will make pebbles which would be suitable as a grinding media, a special grinding test has been devised by the writer. Roughly sized rock, which is representative of the ore from a crusher plant, from a test pit, or slashed from a development crosscut is taken and ground in a mill under operating conditions. The mill is located at the University of Toronto.

In the last 16 months, 14 ore samples have been tested for ten different clients. These grinding tests, run in an identical manner, will determine if any given ore will round up into suitable pebbles and without making more "chips" than the media itself can handle. The pebbles so made can be examined and used by the client as grinding media in laboratory tests at his plant or elsewhere to check the effect of pebble grinding on the process metallurgy.

Ten-In. Ore Ground to Minus 200 Mesh in One Stage

In the past two years there have been several interesting developments in the wet primary grinding field. After pilot plant test work on dry autogenous grinding vs. wet, Quebec Cartier chose single-stage wet Hardinge Cascade mills to reduce run-of-mine iron ore to ten mesh, where the specular hematite ore is treated on Humphrey spirals to concentrate the iron.[12] Where the mill process is wet, the wet grinding mill offers advantages over dry grinding. Quebec Cartier has twelve 18 by 5 ft Cascade mills at its Lac Jeannine concentrator. Each unit has a 600-hp motor and is to handle 4800 long tpd. The concentrator is now in production and mill operating costs will be watched with great interest by the mining industry.

Boliden Mining Co. is currently running a 22 by 7 ft Cascade mill at its Vassbo property in Sweden.[13] This mill has two 800-hp motors driving it and is handling rock from a primary jaw crusher set at ten in. It is wet grinding the ore to 72 percent minus 200 mesh in one stage in closed circuit with a cyclone. The ore is a hard, fine grained lead ore and is said to be quite abrasive.

Boliden started testing its ore in a 10 by 3 ft Cascade mill in 1957. The company compared performance of this mill with conventional, crushing rod milling and ball milling and decided in favor of the all-autogenous grinding unit.

Units of the above type will naturally raise questions regarding the relative cost of these big mills vs. conventional crushing and rod-ball milling plants. An interesting article

on this subject appeared in the March 1960 issue of *Western Miner*.[14]

Taconite Successfully Ground in Test Mill

An interesting development in autogenous comminution is the pilot plant grinding test on hard banded (taconite) iron done by Cleveland-Cliffs on their Empire ore. On a ten-tpd scale, this ore was crushed and ground conventionally by rod milling and two stages of ball milling to 95 percent minus 400 mesh, the grind required for magnetically concentrating the magnetite into an acceptable grade.

The test was then repeated starting with ten-in. run-of-mine ore in a six-ft wet Cascade mill as the primary crushing and grinding step. Fine grinding was done in a grate discharge pebble mill using 1 to 2½-in. rounded pebbles taken from the discharge trommel of the Cascade mill. The pebbles were formed in the Cascade mill and then removed. These two autogenous mills produced the same grind as the conventional crushers rod-and-ball mills for the same net horsepower per ton ground.

The shipping grade of the concentrate from the all-autogenous grinding circuit was two percent higher grade—a decided advantage with an appreciable operating cost saving. (The steel rod and ball consumption is estimated at six to seven lb per ton.) This autogenous pilot plant has also been tried on other iron ores with good results. It is one of the most interesting autogenous grinding developments to date—with a fascinating potential.

It should be emphasized that primary autogenous is still in its infancy; it is still not firmly established and there is little operating data available. However, the wet fine grinding in pebble mills from six mesh to any fineness desired is no longer experimental. South Africa has been doing this for 60 years—we have had no failures in the 12 plants on this Continent in the past 12 years. We can say safely, that if you can grind with steel balls, we can show you how you can grind with your own screened ore pebbles. There are a few tricks but nothing that good engineering design cannot control.

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PRACTICAL USE OF ROCK MECHANICS

(Continued from page 37)

stressed interior of the pillar creates a free face and releases the lateral confining stress. This allows the overstressed coal to rupture suddenly by shearing. The expansion of the fragments which accompany the rupture causes them to project themselves violently into the workings.

Storage of Elastic Energy By Compressed Rock

In those mining districts where the major rock bursts or "pressure bursts" have been a most serious problem the veins have strong, brittle roof and floor rocks. The quartzites of the Witwatersrand, the hornblende schists of the Kolar Gold Field, and the sandstones of the Springhill mines are all very strong rocks with compressive strengths ranging from 20,000 psi to 30,000 psi or more, and with moduli of elasticity in the range from 4,000,000 to 7,000,000 psi.

As an example of the amount of energy which can be stored in a highly compressed rock take a cubic foot of rock with a modulus of elasticity of 6,000,000 psi and subject it to a compressive stress of 25,000 psi. A cubic foot of such rock will store about 7500 ft-lbs or 3¾ foot-tons of energy before fracturing.

When it is subjected to a compressive stress of 25,000 psi, this rock shortens, or compresses, by an amount equal to four-tenths of one percent of its length. Thus a "block" of such rock 100 ft long when subjected to a compressive stress of 25,000 psi will be shortened by about 0.4 ft. This example shows that enormous amounts of elastic energy may be stored in compressed roof or floor rock without any large movement being readily apparent in the workings. It also explains why only small displacement of roof or floor may be evident after a rock burst.

De-Stressing To Prevent Rock Bursts

A technique recently devised for preventing rock bursts at stope faces in deep mines of the Witwatersrand consists of "de-stressing" the rock at the face by drilling holes ten ft deep and three to four ft apart directly into the face and loading and blasting them. The purpose is to create fractures in the rock extending several feet ahead of the face, so that the fractured rock is able to yield slightly and to transfer the peak stress further into the solid ahead of the face. This de-stressing method has greatly reduced the frequency of severe rock bursts where it has been used on the Witwatersrand, and has also reduced roof support problems.

In coal mining operations pillars which are subject to "bumping" have been de-stressed by boring large diameter auger holes thru them. The stress concentration induced by the holes "triggers" bumps and eventually causes fracturing to extend completely through the pillar so that all elastic energy is released.

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Methane Drainage at the "Yugo-Zapadnaya" Mine No. 3 in Russia*

** Translated expressly for Mining Congress Journal from UGOL (coal), May 1960, State Publishing House For Mining Literature, Moscow, Russia, by Royer and Roger, Inc., Washington, D. C.*

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AT the "Yugo-Zapadnaya" Mine No. 3, Donetskugol' Trust, two coal seams are being mined which are dangerous because of methane and coal dust. These are the 0.9 m (3 ft) thick K^1_2 Lisiy seam and the 1.2 m (4 ft) thick i_3 Sukhodol'skiy seam. In addition, the Lisiy seam is dangerous because of coal and gas bursts. Twenty and 58 m (65 and 190 ft) above the Lisiy seam there are two gas-bearing beds, $K^2 2$ and K^3. Methane seeps from these beds into the mined area.

The coal seams i^B_3, i^0_3, i^1_3 occur, respectively, at 7 m (22 ft) and 20 m (65 ft) below and at 15 m (50 ft) and 50 m (165 ft) above the Sukhodol'skiy seam. Gas seeps from these seams into the mined area.

The Sukhodol'skiy seam yields 6.56 cu m (232 cu ft) of gas per ton of daily production while the Lisiy seam yields 48.8 cu m (1723 cu ft). It may appear that because of the lower gas yield, the Sukhodol'skiy seam does not require degassing. Yet, surges in the volume of gas discharged from the accompanying seams leads to sharp and rapid increases in the methane concentration at the face.

Work was initiated in 1957 to remove methane from nearby seams which discharged gas into the mined area. Gas measurements were made at all operating faces and ventilation drifts. They showed that at the faces where methane discharge into the ventilation drifts exceeded three cu m per min (106 cfm) the methane content in the exhaust air exceeded one percent (see fig. 1) and it became necessary to take steps to correct this. Gas measurements showed that face No. 18 in the Sukhodol'skiy seam and face No. 102 in the Lisiy seam required degassing. Boreholes, 125 mm (5 in.) in diameter were drilled from the surface to the vicinity of these two faces. RMK-4 vacuum pumps, as well as control and measuring instruments, were installed at the mouth of each borehole, and 125 mm (5 in.) pipelines were laid from the holes to the sections in the mine selected for degassing.

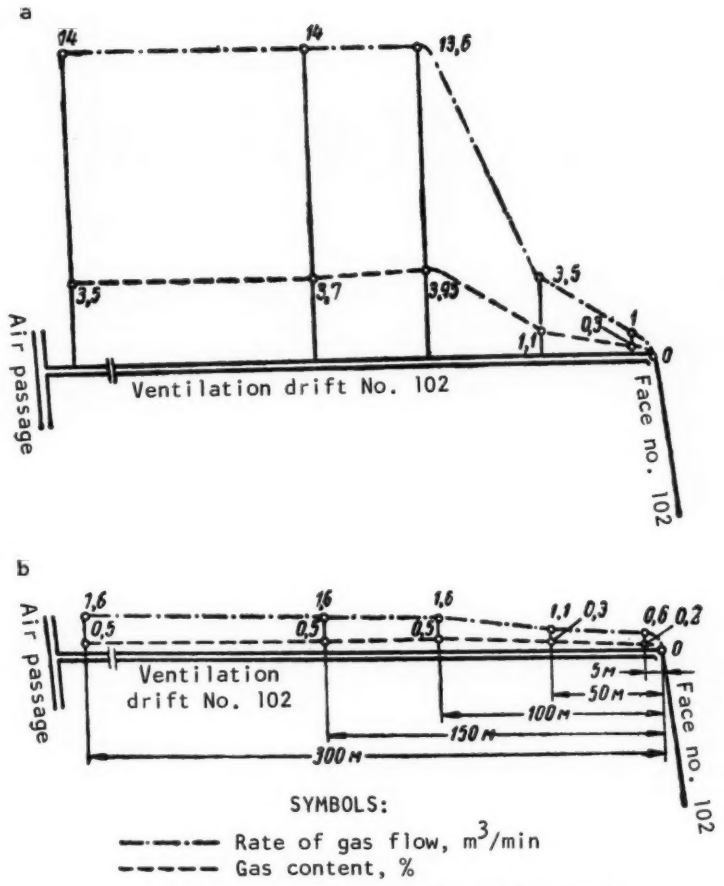


Figure 1. Survey of gas content in the ventilation drift for face No. 102

a—Prior to methane drainage
b—After drainage
NOTE: Mining was discontinued during the survey

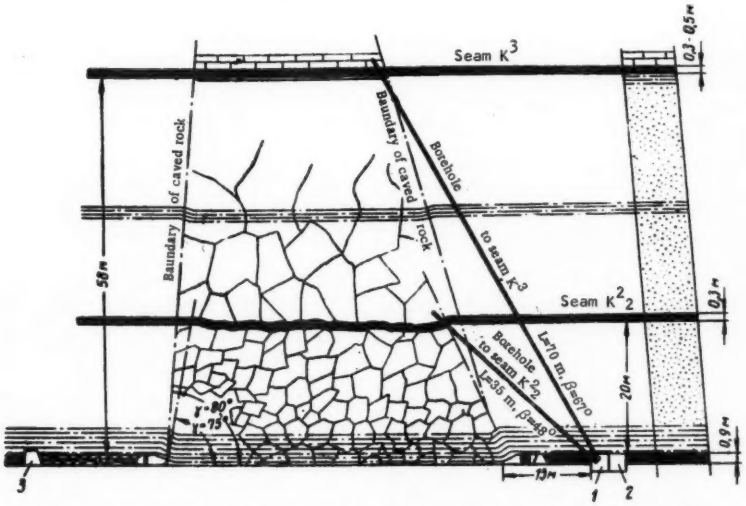


Figure 2. Location of boreholes for draining methane from seams overlying the Lisiy seam K^1_2 in the vicinity of face No. 102

1—Chamber for drilling machine
2—Haulage drift, face No. 102
3—Ventilation drift, face No. 102

[Editors Note: both of the mines described are practicing longwall mining.]

In the case of face No. 18, the drainage holes were drilled ahead of mining and were connected to the pipeline on the section by a valve.

As the face advanced, and the roof caved, the holes were found to be in zones free of rock pressure. "Free" gas from the accompanying beds was drawn off by the drainage holes and withdrawn by the RMK-4 vacuum pump through the main borehole.

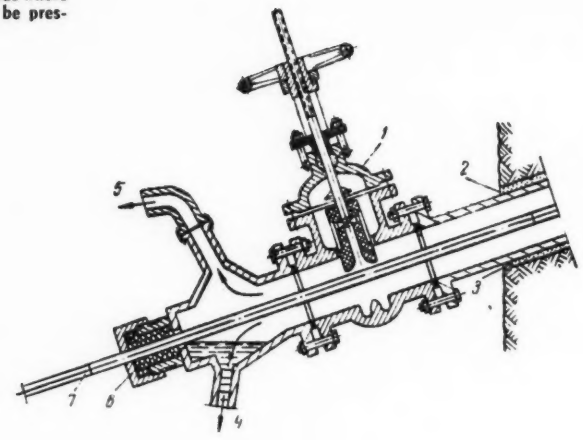
Methane drainage holes were not drilled into the solid above the Lisiy seam in the vicinity of face No. 102 (fig. 1), but into the area which was broken up because of caving brought about by mining in the Lisiy seam. This was done because the face had been idle for a long period of time and there were large accumulations of "free" gas in this fracture zone—or pressure relief zone. Drilling into a pressure relief zone is not advisable, and is in fact dangerous, since the hole is directed towards a gas accumulation, and there is the possibility of gas reaching the drilling machine chamber through the drill hole in sudden bursts. For safe drilling under these conditions, the methane was withdrawn through a special valve during the drilling operation (fig. 3). This eliminated the possibility of gas bursts into the drilling chamber.

The direction of the holes, the distance between holes along the strike, mounting and operation of the degassing units were in accordance with the recommendation of the State Makeyev Scientific Research Institute for Safety in the Mining Industry (MAKNII).

The holes were drilled with a KAM-2m-300 type machine. The average drilling rate in hard rock was 3 to 4 m (10–13 ft) per shift, and 1.5 to 2 m (5–6 ft) in very hard sandstone. Hard alloy reinforced core bits were used. The boreholes were hermetically sealed with a cement solution which was pumped into the hole (the space around the casing pipe) under pressure. Water was removed from the collectors of the gas pipe at the holes, and from the lowest points in the pipe, by water traps, i.e., simple water seals. Two to three boreholes were used to drain methane from one face; in cases where underlying gas-bearing beds were present, from four to six holes were used.

The experience from degassing the underlying beds of the Sukhodol'skiy seam shows that holes drilled into these beds are not very effective since they fill up with water. For this rea-

Figue 3. Device for drilling methane drainage holes into gas-bearing rocks or into pressure relieved areas where gas may be present



1—Valve; 2—Mouth of hole; 3—Casing pipe; 4—Water to water-seal; 5—Gas to vacuum pump or to general exhaust air stream; 6—Packing box; 7—Drill rods.

son, drilling of down holes was discontinued.

Each vacuum pump station was provided with two pumps—one being a standby unit.

While the methane drainage system was working, there was no excess gas in the air streams coming from the faces or sections, except when a pump broke down. A survey of the gas content in the ventilation drift of face No. 102 after degassing showed that methane discharge dropped to 0.6–1.6 cu m per min (21–56 cfm) (Fig. 1).

The results of the vacuum-pump station operations are given in the table.

At the present time methane drainage is being carried on at three mine faces. Moreover, two new faces of the sloping portion of the Lisiy seam have been prepared for methane drainage.

A project for the industrial utilization of the gas for heating dwellings and other buildings above ground is under study. It is anticipated that from 350 to 600 tons of coal can be saved monthly by burning the collected methane. The economics of using the gas for industrial purposes will justify both the expense of maintaining the degassing stations and the capital expenditures required to initiate degassing operations.

Vacuum pump station	Type of pump	Operating vacuum	Capacity at given vacuum	Gas content in pumped mixture percent	Quantity of gas pumped	Methane content in ventilation drifts No. 18 and No. 102 in percent	
						Prior to degassing	With pumps operating
Southern Sukhodol'skiy Seam	RMK-4	300 mm H_2O 11.8 in. H_2O	18m³/min. 635 cfm	35	8000 m³/day 282,000 cu. ft/day	1.5	0.5
Northern Lisiy Seam	RMK-4	350 mm H_2O 13.8 in. H_2O	16m³/min. 565 cfm	60	14000 m³/day 494,000 cu. ft/day	3.5	0.5

THE REPORT CORNER

Recent Publications of Interest to Mining Men

USBM RI 5732. "Performance of Dense-Medium Cyclone in Cleaning Fine Coal," by M. R. Geer, Michael Sokaski, P. Stanley Jacobsen, and H. F. Yancey.*

USBM RI 5740. "Recovering Cobalt and Nickel from Complex Sulfide Ores of Southeastern Missouri," by K. K. Kershner and F. W. Hoertel.*

USBM RI 5741. "Using a Centrifuge for Float-and-Sink Testing Fine Coal," by E. R. Palowitch and T. M. Nasiatka.*

USBM RI 5750. "Beneficiating North Carolina Spodumene-Beryl Ores," by J. S. Browning, B. H. Clemmons, and T. L. McVay.*

USBM RI 5754. "Removing Quartz and Other Impurities from Refractory Clays by Mineral Dressing Methods," by W. A. Calhoun and H. E. Powell.*

USBM RI 5762. "Effects of Particle Size Upon the Green Strength of Iron Oxide Pellets," by R. P. Jewett, C. E. Wood, and J. P. Hansen.*

USBM RI 5779. "Beneficiation of Red Iron Ore Fines from Pyne Mine, Bessemer, Ala.," by W. E. Lamont, I. L. Field, and B. H. Clemmons.*

USBM RI 5760. "Statistical Analysis of Gallery Variables Affecting the Probability of Ignition by Explosives," by R. L. Grant and R. W. Van Dolah.

USBM RI 5771. "Laboratory Concentration of Seven Titanium-Bearing Ores of the Pacific Northwest," by J. W. Town and C. W. Sanders.*

USBM RI 5774. "A Boron-Base Refractory," by Perry G. Cotter.*

*** Available from Publication Distribution Eection, Bureau of Mines, 4800 Forbes Ave., Pittsburgh 13, Pa.**

USGS Bulletin 1115. "Bibliography of North American Geology, 1958," by Ruth Reece King and others. Superintendent of Documents, Government Printing Office, Washington 25, D. C. Price: $2.00.

"Legal Guide for California Prospectors and Miners," Revised Edition—1960. State of California Division of Mines, Ferry Bldg., San Francisco 11, Calif. Price: $1.00.

"Modern Sulphur Mining," Revised Edition. Texas Gulf Sulphur Co., Sales Department, 75 East 45th Street, New York, N. Y. Free.

HORIZONTAL AIR DRILLING

A horizontal, rotary air drill is averaging 360 ft of 6¼-in. blast hole per hour at Peabody's Power mine

By N. O. LEWIS
Chief Engineer
Robbins Machine & Manufacturing Co.

HORIZONTAL or sidewall drilling in the mining industry is not new. In fact, until the introduction of the large diameter rotary vertical drills within the last few years, horizontal drilling was used throughout the industry.

The large diameter rotary vertical drills were developed through necessity as the overburden increased. More rock was encountered and better fragmentation was required if coal was to remain competitive.

The large vertical rotaries were fast and could penetrate the hard rock. With the new nitrate-type explosives and the big blasthole, good fragmentation could be achieved at an economical cost. But these large diameter rotary vertical drills presented new problems. Timber had to be cleared and drill roads prepared. Wet weather and spring thaws mired the drills in soft ground. Men and equipment were required to supplement the new drills.

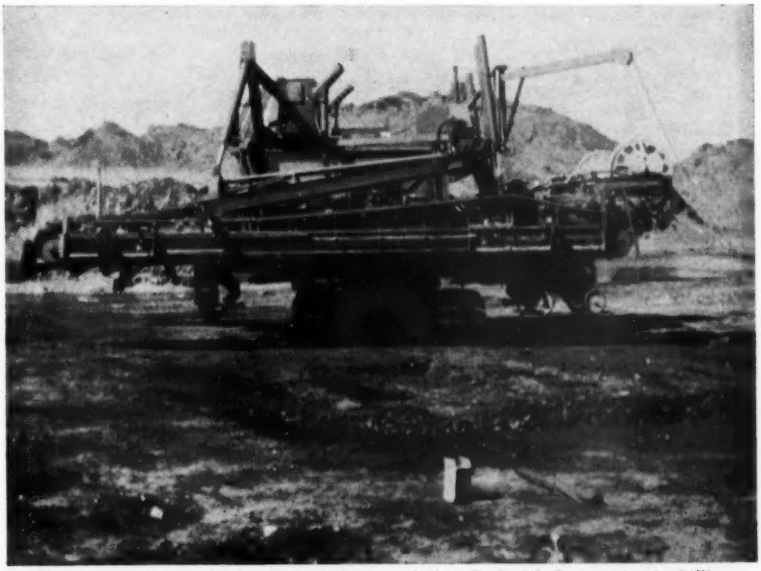
The new problems were recognized, but, since the over-all results were outstanding and little progress was made in the development of improved horizontal drilling equipment, these problems were more-or-less accepted. (We must keep in mind that the horizontal or sidewall drilling equipment would not then penetrate the harder material and rock in a satisfactory manner.)

There were, however, mines in the field where the over-burden did not warrant the use of a big vertical rotary drill. Because of this, and even though it was obvious that faster and better horizontal drilling equipment would be required to stay abreast of the progress in stripping equipment, many of the mines continued with horizontal blastholes. These mines were responsible for stimulating and assisting in the design and development of improved, higher production horizontal or sidewall drilling equipment.

Improvements were made in the auger type drills, with mines often fabricating their own equipment. At this time, at least one progressive company is producing a very good high production auger sidewall drill for its own use.

Machines Are Fast and Will Penetrate Rock

In the search for higher production and more versatile equipment, the possibilities of horizontal rotary drilling with air were considered. Manufacturers of vertical rotary drilling equipment were consulted, and experimental machines were produced and tested.



The twin-head or dual mast horizontal rotary drill at Peabody's Power mine is drilling 6¾-in. holes in hard shale interlaced with pyrite inclusions, and a layer of limestone rock is often encountered. Production of over 2000 ft of drilled hole in a regular shift is not unusual

Specifications

Robbins Horizontal Rotary Drill

Model HD-100E

Dual Masts

Independent hydraulic adjustment for each mast.
Drill masts position from two ft above ground level to eight ft above ground level for horizontal drilling.
Drill masts position from 10° below horizontal to 15° above horizontal for angle drilling.

Drill Traverse

Hydraulic drill motors utilized to power wide track crawlers.
Drill pivots full 360°
Crawlers may be jacked clear of ground and pivoted 360° to abruptly change direction of traverse.

All Electric—455 Total HP

One 500 kva transforms incoming 4160 voltage to 440 volt a-c.
Two 75-hp variable speed, constant torque, instant reversing motors power the bit rotation.
Two 40-hp constant speed motors power the hydraulic system.
Two 10-hp constant speed motors power the dust control system.
One 200-hp constant speed motor powers the 1500-cfm air compressor.
One 5-hp constant speed motor powers the auxiliary control compressor.

Air Compressor

Heavy-duty Joy Piston, single stage, dual control compressor provides 750 cfm of air at 50 psi to each mast for chip removal.

Leveling Jacks

Four heavy-duty, 10¼-in. hydraulic jacks level and stabilize the unit for drilling.

Dust Control

Adjustable dust collecting bonnets are set to the drill face.
Two Type D, rubber backed Roto-clone collect dust at the drill face and exhausts above the drill.

Drilling Pressures

Up to 80,000 lb pressure on each bit.

Drilling Speeds & Torque

40 rpm—80,000 in.-lb
60 rpm—80,000 in-lb
80 rpm—80,000 in-lb
120 rpm—80,000 in-lb

NOTE: Electric drive motors will provide much higher overload torques.

Drill Head Traverse

Forward: 8 fpm—80,000 lb pressure.
15 fpm—60,000 lb pressure.
60 fpm—40,000 lb pressure.
Retract: 120 fpm—40,000 lb pull.

Drill Pipe

Semi-automatic, remote controlled pipe changing adds and removes smoothly 30-ft drill pipes to and from the drill stem.

Depth of Hole

Three sections of pipe in each drill mast provides an effective hole depth of 88 ft.

Controls

All controls centrally located in air-conditioned cab, which is equipped with one-in. bullet-proof glass and sturdy deflection members for maximum operator protection against falling rocks.

Construction

All steel, extra sturdy, capscrew and welded construction.

Overall Dimensions

Width: 32 ft.
Length: 47 ft.
Height: 25 ft.

Over-all Weight

Approximately 300,000 lb.

Successful equipment was developed and large capacity, high production horizontal drills have been in use for over a year. The machines are of necessity large and heavy, but they are fast and will penetrate rock.

The improvements and new developments are, without question, promoting horizontal blasthole drilling. It is expected that more and more consideration will be given to horizontal drilling in the future.

When Is Horizontal Drilling Applicable?

When the possibility of horizontal drilling is considered, no set rules can be defined because the overburden at each mine presents a different problem, and the blasting and fragmentation requirements also differ. The requirements of the equipment and the practicability must also be considered. The writer can, however, think in generalities and consider overburden conditions in general with the understanding that he is using, more-or-less, a rule of thumb method.

In general, overburden which contains thick rock located relatively high above the coal, or overburden which contains layers of rock extending relatively high above the coal, presents an accessibility problem to horizontal drilling equipment working from the pit floor.

Equipment can, of course, be designed that will drill horizontal holes at extreme elevations above the pit floor; however, this type of equipment would, of necessity, be very large, bulky, and very expensive.

The more modern horizontal drills are designed to angle the hole upward toward or into the rock. However, the angle is limited and angled holes may or may not produce the blasting or fragmentation results required. This depends upon the type of formation and material encountered. When the rock and harder material is of a thinner nature, and located at a lower elevation with softer material located above, horizontal drilling and blasting is most applicable and very economical.

Advantages Include Elimination of Road Work

The advantages of horizontal drilling are numerous. The drilling equipment works from and traverses on the pit floor, which provides a stable and relatively consistent foundation. This eliminates the costly and time-consuming road and preparation work required by the vertical drilling equipment which works on the highwall. It also eliminates the downtime

due to miring in soft ground, which usually requires additional manpower and equipment. In many parts of the country, the working of drilling equipment on unstable ground during wet weather and spring thaws constitutes a major and costly problem.

Horizontal holes may often be located just below the predominate hard rock in shale-like, softer material. Penetration rates are high and bit cost is low when drilling in this type of formation.

Because the entire horizontal hole is usually located directly in or just below the rock or harder material, a minimum linear feet of hole is required.

Two Major Methods Available

There are, at present, two major methods of horizontal drilling which may be designated as follows: auger drilling without air, and rotary drilling with air.

In auger drilling without air, flights on the drill steel or drill pipe are used to auger or screw the drilled material from the hole. A claw or drag-type bit is used to dig or cut the material.

Although auger drilling is relatively slow due to the limited rpm of the flights and drill steel, most of the horizontal drilling has been accomplished via the auger method. As the auger drill will not satisfactorily penetrate rock and harder materials, horizontal drilling has been limited to formations which allow drilling only in shale and softer materials.

In rotary drilling with air, a smooth drill steel or drill pipe is used. Compressed air flowing through the drill steel is exhausted through the bit, blowing the chips and drilled material from the hole at a high rate of speed. The same rotary-type bits used on the vertical rotary drills are used to chip the material. This type of drill will penetrate shale and rock as conditions require.

With properly designed equipment, the penetration rates are high in both rock and shale. Rock is being drilled with the new horizontal rotary equipment at penetration rates comparable to the heavy-weight vertical rotary drills. Shale-type formations have been drilled at very high penetration rates.

A 150-Ton Twin-Head Drill Is Used at the Power Mine

The twin-head or dual mast horizontal rotary drill working at the Power mine, Peabody Coal Co., Montrose, Mo., although capable of drilling 12-in. diam holes, is now drilling 6¾-in. diam holes in hard shale interlaced with pyrite inclusions, and a layer of limestone rock is often encountered. Production of over 2000 ft of drilled hole in one regular shift is not unusual in this formation, and the average penetration rate is approximately 360 linear ft of hole per hour. In tests made by the manufacturer in drilling shale, penetration rate was as high as 30 ft of 10⅝-in. hole in 40 seconds.

The drill weighs approximately 300,000 lb, has a drilling pressure on each mast up to 80,000 lb, and a drilling torque of 80,000 in.-lb at speeds ranging from 40 to 120 rpm is provided with constant torque, 75-hp electric motors. The drill heads will drill forward at a maximum speed of 60 fpm and retract at a maximum speed of 120 fpm. To blow the chips and material from the drilled hole, 750 cu ft of air at 40 psi is provided at each hole. Three 30-ft drill steels or drill pipes are carried in each mast which provides a maximum hole depth of 90 ft. The 30-ft sections of drill pipe are introduced into and removed from the drill stem with semi-automatic controls located in the control room or cab.

Semi-automatic or automatic handling of the drill pipe sections is an absolute requirement on any type of high penetration horizontal drilling equipment if high production is to be realized. The industry cannot afford the cost of high penetration drilling equipment that is severely penalized by slow, time-consuming drill pipe changing methods.

The twin-head or dual mast feature controlled and operated by one operator is, of course, time saving. It is not, however, required in horizontal drilling, and it is visualized that less expensive single-head or mast, high production units will be available in the near future.

Horizontal drilling will not, nor is such an implication intended, replace vertical drilling of formations that are not adaptable to horizontal drilling and blasting. The advantages of horizontal drilling, however, should merit careful consideration.

Auger Versus Rotary Drilling

Should the formation be adaptable, and horizontal drilling is to be used, the question of methods remains: auger drilling without air, or rotary drilling with air.

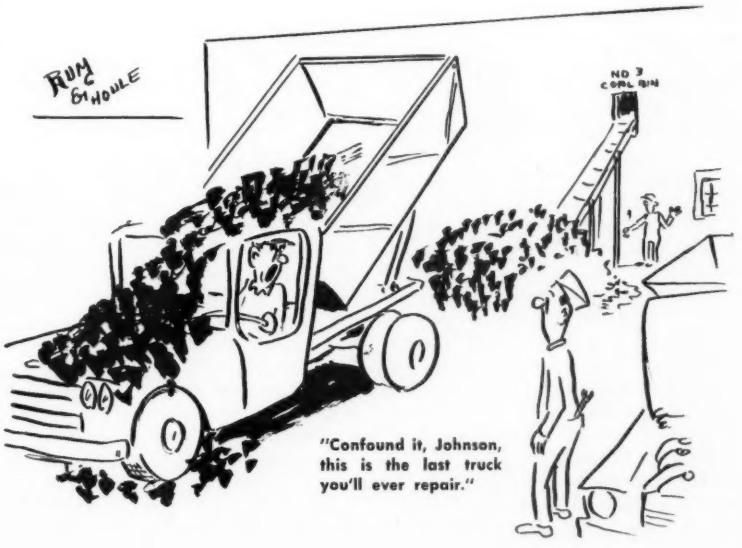
This question involves all the factors and variables involved in analyzing any piece of equipment, and only the equipment user is in a position to resolve this question.

Some of the advantages and disadvantages of each method may, however, be summarized as follows:

Auger drilling equipment requires less initial investment, and it is less bulky. Production rates are usually relatively slow, and the harder formations cannot be drilled satisfactorily.

Rotary drilling equipment requires more initial investment and is more bulky. Production rates are high and the harder formations can be drilled satisfactorily.

Horizontal drilling is and will become more important in the mining industry. The industry and only the industry will decide when, where, and to what extent horizontal drilling fits into the over-all production of coal.



"Confound it, Johnson, this is the last truck you'll ever repair."

As Viewed by HENRY I. DWORSHAK of the American Mining Congress

Although Congress continues to make steady progress in implementing President Kennedy's legislative recommendations, many lawmakers now expect the current session of Congress to run until Labor Day or later. As reasons they cite the international situation—including the status of Berlin if the Soviet Union signs a peace treaty this year with East Germany, as Premier Krushchev has indicated—and probable lengthy debate over the Administration's proposed five-year foreign aid program.

Congress has extended for another year the current 52 percent tax rate on corporations; various excise rates on alcoholic beverages, cigarettes, automobiles, passenger transportation, and telephone service. Other tax recommendations of the President, including more favorable tax treatment for money invested in new plants and equipment, are still being considered by the House Ways and Means Committee.

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Washington Highlights

CONGRESS: Lengthy session foreseen

FUELS STUDY: Coal spokesmen support Senate resolution

LEAD-ZINC: Plan to aid industry draws criticism

IRON ORE: Committee hears views on status of research

WATER POLLUTION: Senate passes amended measure

IMPORTS, EXPORTS: Effect on employment studied

SAFETY: Rules Committee kills small coal mine bill

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COAL SPOKESMEN ENDORSE NATIONAL FUELS STUDY

Prompt inauguration of a thorough study of existing and prospective fuel and energy resources and requirements of the United States was urged by coal industry spokesmen at a two-day Senate Interior Committee hearing last month. Under consideration by the Committee at the time was a resolution calling for such a study by a special Senate committee.

Interior Secretary Udall endorsed the study on behalf of the Administration. "We cannot let policy affecting resources as important as fuels and energy be set by drift, by default, or by piecemeal actions which do not reflect such paramount considerations as the future health of our economy, national security, and our concern for the well being of the free world," he told the Committee.

Coal representatives outlined the need for the study as a preliminary step to formulation of a national fuels policy to serve the long-range best interests of the Nation. They included George H. Love, chairman of the board, Consolidation Coal Co., and chairman of the National Coal Policy Conference; Stephen F. Dunn, president, National Coal Association; Joseph E. Moody, president, National Coal Policy Conference, and Julian D. Conover, executive vice president, American Mining Congress.

Conover pointed out that the proposed study "is of concern to all producers and to all consumers of energy—in other words, to every citizen of our country. We believe that an impartial, objective study will be of great value to the Congress as a basis for establishing sound policies for the future."

Opposition to the study was voiced by some segments of the oil and gas industries—on the basis that fuels reserves and availability are continuing to keep pace with national needs and that there is no need at this time for a special study of fuels and energy.

The Senate Interior Committee has not announced when it will give further consideration to the fuels study resolution.

INTERIOR DEPARTMENT OFFERS LEAD-ZINC AID PLAN

After insistent prodding by the House and Senate Interior Committees, the Interior Department last month put forth a tentative proposal to aid the depressed domestic lead-zinc mining industry—but it was soon withdrawn as a result of a storm of Congressional disapproval.

Main features of the abortive proposal were (1) a plan whereby dollars obtained from sale of surplus farm commodities to other countries would be used to purchase domestic surpluses of lead and zinc for the supplemental stockpile, and (2) a reappraisal and adjustment of the Treasury's silver selling policy aimed at increasing the market price of silver to 99 cents or $1 per ounce. Nonmonetized silver in Treasury stocks is now sold to industry and the arts at 91 cents an ounce.

Mechanics of the barter program were not spelled out, but it was indicated that brokers or other "middlemen" would be involved. As to silver, it was explained that a higher price would benefit many lead-zinc mining companies who produce silver as a by-product, particularly in the West.

Western members of Congress were quick to express their disappointment over the Interior Department proposal, terming it a token gesture which would not solve the basic problem of excessive imports of lead and zinc. Shortly afterward it became known that the proposal had been dropped.

IRON ORE RESEARCH AIRED AT SENATE HEARINGS

Various aspects of iron ore research, with particular emphasis on economic beneficiation of the vast low-grade reserves of the upper Great Lakes area, were discussed at a recent

all-day hearing conducted by the Senate Interior Subcommittee on Minerals, Materials and Fuels.

Marling J. Ankeny, director of the U. S. Bureau of Mines, testified that Bureau research had contributed to development of a beneficiation process which had made low-grade magnetic ores — taconite — economically useful. The domestic iron and steel industry has invested about $600 million in plants which convert taconite into high-grade pellets that are extremely desirable as blast-furnace feed, Ankeny noted.

Despite this break-through, Ankeny stated, prices of steel and steel products would be forced sharply higher if the steel industry were required to cut back on imports of high-grade foreign ores with which it supplements domestic ores. Earlier, Rep. Bennett (Rep., Mich.) had suggested that the Subcommittee consider recommending imposition of import quotas on iron ore to require greater dependence on domestic ores and, in turn, to boost employment in iron mining areas.

Hugo E. Johnson, president, American Iron Ore Association, said that his industry has for over 40 years been conducting research directed toward making low-grade deposits in the Great Lakes area available to industry. He added:

"These research efforts and subsequent process development work have resulted in technologies that have been applied successfully in seven commercial low-grade iron ore processing plants in the upper Great Lakes areas.

"The industry does not intend to let up its research program. Already several companies have constructed pilot plant facilities to determine engineering and economic data for the processing of the large deposits of so-called semi-taconites of the western end of the Mesabi Range and other oxidized iron formation materials of the entire upper Great Lakes area. It is conceivable that if these processes prove favorable, on the basis of over-all economics, new facilities will be constructed providing additional employment and large tonnages of high-grade iron ore from a previously uneconomic iron ore."

Johnson also expressed the industry's belief that increased Federal expenditures on iron ore research are neither desirable nor appropriate at this time.

Subcommittee Chairman Carroll (Dem., Colo.) then read a letter from Senator Hart (Dem., Mich.) in which Hart asserted that development of low-grade iron ore resources of the upper Michigan peninsula has been handicapped by a shortage of funds to accelerate research.

No specific legislation was being considered at the hearing, which was adjourned subject to the call of the chairman.

SENATE PASSES AMENDED WATER POLLUTION BILL

Refusing to accept the House-passed Blatnik bill to strengthen the Federal Water Pollution Control Act, the Senate late last month adopted substitute language proposed by the Senate Public Works Committee and returned the measure to the House. Conferees are now attempting to compromise differences.

Both versions would extend Federal authority in water pollution control to all "navigable" and coastal waters regardless of whether interstate pollution is involved, but they differ on procedures to enforce abatement.

As passed by the House, the bill would empower the Secretary of Health, Education and Welfare to issue abatement orders. Any such order would, however, be subject to appeal to a Federal circuit court of appeals. The Senate version would retain virtually unchanged the present Act's enforcement procedures, under which the Surgeon General, as the final step, may request the Justice Department to bring suit in Federal district court to secure abatement.

EFFECTS OF IMPORTS, EXPORTS ON EMPLOYMENT UNDER STUDY

A House Labor subcommittee under the chairmanship of Rep. Dent (Dem., Pa.) has begun a series of public hearings aimed at determining the effects of imports and exports of various basic commodities on employment in this country. The kick-off session was related primarily to the coal industry.

Coal witnesses directed the bulk of their testimony to condemnation of imports of residual fuel oil, which they termed "unreasonable" and "excessive." United Mine Workers President Thomas Kennedy, estimating that 55 million tons of coal annually are displaced by imported residual fuel oil, said that import quotas on this fuel must be strengthened because the only other alternative is the degeneration of domestic energy industries.

On the other hand, a petroleum industry research official asserted that a stiffening of controls on imported residual oil "would not make a dent in the coal industry's unemployment problems" because, he said, only 6 million tons of coal annually are directly in competition with residual oil.

Following the hearing, Chairman Dent stated that numerous communities in eastern coal mining areas would "automatically emerge" from the distressed area classification if residual oil imports were prevented from usurping much of coal's markets on the East Coast. Atlantic Seaboard consumers who demand unrestricted volumes of oil imports are "provincial and selfish," he charged, pointing to New England business groups who demand unrestricted shipments of foreign residual oil while insisting upon quotas and tariffs on imported textiles, fish, shoes and other commodities which compete with their products.

RULES COMMITTEE KILLS COAL MINE SAFETY BILL

The House Rules Committee, which serves as a legislative "traffic cop" between other Committees and the House floor, has refused to grant clearance to a bill to extend the enforcement provisions of the Federal Coal Mine Safety Act to mines normally employing not more than 14 persons underground. This means that the measure is dead unless the Rules Committee reconsiders its action, which happens only rarely.

Under this bill, the U. S. Bureau of Mines would be empowered to close down unsafe small mines until the unsafe conditions are corrected—authority which it already has with respect to larger underground coal mines. The House Education and Labor Committee earlier had approved the proposal, which has the strong backing of the United Mine Workers of America.

"We had to—he keeps getting lost below."

personals

R. E. Salvati, president of Island Creek Coal Co. since 1949, has been elected chairman and chief executive officer of the company and its subsidiaries. At the same time, **James L. Hamilton,** executive vice president for the past five years, was named president and chief administrative officer.

Salvati has been associated with Island Creek for 39 years. He became

R. E. Salvati

J. L. Hamilton

general manager of the company in 1936, vice president in 1940, and a director in 1942. He is president of the American Mining Congress and a director of many organizations including the National Coal Association, National Association of Manufacturers, and Norfolk & Western Railway Co.

Hamilton joined Island Creek in 1949 as vice president of operations. Previous to that he was manager of coal operations for Republic Steel Corp. He was with Republic for 15 years and had earlier been with Youngstown Sheet & Tube Co. In 1955 he became a director of Island Creek, and was named executive vice president the following year.

Island Creek also announced that **A. L. Lynn** has been elected president of Carnegie Dock & Fuel Co. He has been vice president of Island Creek for 12 years and executive vice president of Carnegie Dock.

James P. Giles, Jr., former executive vice president, has succeeded **Walter C. Russell** as president, chief executive officer and chairman of the executive committee, American Cement Corp. Russell, who has served American and predecessor companies since 1933, will continue as vice chairman of the board, member of executive committee and consultant.

J. P. Giles

W. C. Russell

Giles began his career in the cement industry in 1951, joining Hercules Cement Co. as assistant to the president. He had previously been plant manager for Dewey and Almy Chemical Co. In 1958 he became president of Hercules and in 1960 was elected executive vice president of American.

Frank R. Milliken, president of Kennecott Copper Corp., has succeeded **Charles R. Cox** as president of the Copper Products Development Association, Inc. Cox, who recently retired as president of Kennecott, also retired as president and as a director of the Association.

Herbert E. Jones, president of Amherst Coal Co., has been named a director of Bituminous Coal Research. He replaces **L. Newton Thomas,** president of Carbon Fuel Co., who had served the organization for six years, the maximum term permitted.

Richard C. Pistell, chairman of Pistell, Crow, Inc., New York investment banking firm, has been elected to the newly created position of chairman of Goldfield Consolidated Mines Co.

G. A. Shoemaker, president of Consolidation Coal Co., has been elected a director of Norfolk and Western Railway. He will also serve on the railroads finance committee.

Charles L. Nielsen was recently elected vice president of finance for Copper Range Co. He had previously been a partner in the accounting firm of Scovell, Wellington & Co., directing auditing, systems and procedure work for some of the country's largest corporations.

Samuel G. Lasky has been appointed assistant director of the Office of Coal Research in the Department of the Interior. Lasky, a career employe of the Department for 30 years, is a nationally known mining engineer, geologist, and author. After nine years in the mining industry, he joined the Department's Geological Survey as a field geologist in 1931. He subsequently became regional geologist and chief of a national mineral resource appraisal branch. In 1951 he transferred to the Office of the Secretary where he served in several staff positions until this appointment.

August J. Breitenstein, assistant vice president-raw materials, U. S. Steel Corp., was designated a "Distinguished Alumnus," by the Ohio State University at its Annual Conference for Engineers held at Columbus, April 28. Breitenstein joined U. S. Steel as a mining engineer with H. C. Frick Coal & Coke Co. in 1941 after ten years experience in the antracite fields of eastern Pennsylvania He has been assistant vice president of raw materials for two years prior to which he was director of exploration and planning.

Theodore B. Counselman, consulting metallurgical engineer and secretary-treasurer of Behre, Dolbear & Co., has been awarded Columbia University's Alumni medal for "service of exceptional merit" to the University and the School of Engineering of which he is a 1910 graduate. Counselman's engineering career began with sulphur exploration in Texas. He later worked for Consolidated Copper Co. and Mesabi Iron Co. Counselman was associated with Dorr Co. for 28 years.

Three promotions have been announced by Climax Molybdenum Co. **Frank Windolph** is now general superintendent and has been succeeded as assistant general superintendent by **William Distler. Charles Cleeves,** assistant mine superintendent, succeeds Distler as mine superintendent.

F. Windolph

Windolph joined Climax in 1937 as a mill sampler and worked his way up to mill shifter in 1943. By 1956 he had become mill superintendent, and in 1959 was named assistant general superintendent of Climax operations. Distler was with Miami Copper Corp. for 15 years until becoming assistant mine superintendent at Climax in 1954. He was promoted to mine superintendent in 1956. Cleeves has been assistant mine superintendent for five years. Prior to that he was mine safety inspector.

W. Distler

C. Cleeves

C. T. Dahlin, general manager of the Princess Elkhorn Coal Division, Princess Coals, Inc., has been elected president and a director of the Big Sandy-Elkhorn Coal Operators Association. Elected as first and second vice presidents, respectively, were **B. F. Reed,** treasurer, Turner Elkhorn Mining Co., and **George E. Evans, Jr.,** president, Evans Elkhorn Coal Co.

Floyd S. Weimer, manager of the Great Falls reduction department of the Anaconda Co., has retired. **Lawrence J. Ingvalson,** general superintendent of the Great Falls plant, succeeds Weimer; and **Leonard C. Powell,** assistant general superintendent, becomes general superintendent.

Weimer was associated with Anaconda for 44 years; joining the company at Great Falls as a laborer in the zinc plant. He became general superintendent in 1941 and manager of the Great Falls department in 1953.

C. R. Montgomery, formerly carbonization engineer, Pittston Clinchfield Coal Sales Corp., has been promoted to vice president of research and technical services. Montgomery joined Pittston Co. in 1953 as a consulting engineer and was later transferred to Pittston Clinchfield as carbonization engineer.

Charles T. Holland, head of the Department of Mining Engineering at Virginia Polytechnic Institute, will become dean of the School of Mines at West Virginia University. He will take over his new post in August, succeeding the late G. Ralph Spindler.

Norman C. Williams, vice president and chief geologist of Beryllium Resources, Inc., has resigned as professor of geology at the University of Utah. He will devote his full time to activities of Beryllium Resources.

George Fumich has been appointed director of the Office of Minerals Exploration, U. S. Department of the Interior. Fumich has been attorney and real estate manager for Christopher Coal Co. since 1949. He succeeds **Frank E. Johnson,** who has served as acting director and will continue as deputy director.

Asbestos Corp. (Explorations) Ltd. has announced two recent appointments.

W. G. Stevenson has been named regional manager for western Canada and Alaska, and has opened an office at 814 Metropolitan Bldg., 837 West Hastings St., Vancouver 1, B. C.

W. G. Stevenson

J. H. Bright

J. H. Bright was named district superintendent for the western United States. His address is 341 Mosswood Lane, Santa Rosa, Calif.

Michael A. Kuryla has been named manager of the Lima, Peru, Division of Cerro de Pasco Corp. **Manuel Llosa** became deputy manager at the same time.

William Berry, head of petrographic research for Bituminous Coal Research, Inc., has been appointed a member of the International Committee on Petrographic standards. Berry and **William Spackman** of Pennsylvania State University are the U. S. representatives on the committee.

Harold B. Schmidhauser, founder and director of the American Management Association's course in executive action, has been appointed director of public and industrial relations for New York Trap Rock Corp.

Robert T. Lardon has become purchasing agent of the Commodities and Engineering Division of New Jersey Zinc Co. At the same time, **Frank A. Messenger** was named purchasing agent of the Ores and Metals Division.

Harold E. Robbins, assistant manager of Andes Copper Mining Co., Portrerillos, Chile, has been presented the Distinguished Alumnus Award by Wisconsin Institute of Technology. Robbins is in charge of the multimillion dollar El Salvador copper mine and concentrator project. He began his employment as a mine foreman with Andes Copper in 1938. In 1953 he was named general superintendent and in 1960, assistant manager.

John W. Harshbarger has become head of the Department of Geology at the University of Arizona, succeeding **Francis W. Galbraith** who retired in 1960. Harshbarger was previously professor of geology. From 1950 to 1959, he was with the U. S. Geological Survey.

At the same time, it was announced that **John W. Anthony,** associate professor of geology, has been named curator of the mineralogical museum in the College of Mines.

Robert L. Thompson, superintendent of the Anaconda Company's East Helena, Mont., slag treating plant, retired on June 1. Thompson came to the East Helena plant when it was constructed in 1927. He has been there continuously since, advancing from chief chemist to metallurgist, assistant superintendent and then to superintendent in 1956.

NEWS and views

Republic Steel and Island Creek Will Develop New Virginia Coal Mine

A new 1,200,000-ton coal mine will be developed jointly near Grundy, Va., by Republic Steel Corp. and Island Creek Coal Co.

In making the announcement, T. F. Patton, Republic's president and chief executive officer, and R. E. Salvati, chairman of the board and chief executive officer of Island Creek, said a new corporation, the Beatrice Pocahontas Co., will be formed by the two companies to develop and operate the Beatrice mine. Closing transactions are expected to take place within the next two months upon completion of financing and related arrangements. The new mine will be in Buchanan County, near Grundy, Va. It will be served by the Norfolk & Western Railway Co.

The mine, which will require a multi-million dollar investment, will yield a high quality, low ash, low sulphur, Pocahontas No. 3 seam metallurgical coal. It will be equipped with the most modern mining and preparation equipment available and, because of its recoverable reserves, will be engineered for long life. Coal reserves are being acquired by sublease from Island Creek. Patton indicated, "The new company will give Republic not only an adequate reserve, but also a ready supply of one of the finest, low volatile coals available anywhere." He said, "Island Creek, because of its outstanding record in the mining and marketing of coal, will manage the new company."

Coal from the Beatrice mine will be used by Republic at its steel plants in Cleveland, Youngstown, Warren, Canton, and Massillon, Ohio; Chicago, Ill.; and Buffalo, N. Y. Island Creek Coal Sales Co., a subsidiary of Island Creek, will market a portion of the output.

AMC STAFF CHANGES

The following changes have been announced in the staff of the American Mining Congress.

Laurence P. Sherfy is joining Mid-Continent Oil and Gas Association as legal counsel, and **Martin C. Dwyer** has accepted the post of Manager of the Construction Equipment Exposition and Road Show, the largest indoor industrial exhibit in the world. Both Sherfy and Dwyer have become well known in the mining industry, Sherfy because of his efforts in the tax field and Dwyer for his work in conventions and expositions.

Glenn F. Jackson, formerly assistant editor of Mining Congress Journal, has been named an assistant convention-exposition manager and assistant advertising manager of Mining Congress Journal. In addition, **Phillip A. Dempsey** has joined the Mining Congress, also as an assistant manager in these activities.

Jackson joined Mining Congress Journal in 1956. A mining engineer, he has had wide experience in many phases of mining and brings an extensive knowledge of mining equipment to his new position. Dempsey comes to the Mining Congress from the Cleveland Convention Bureau where he served as convention manager. A native Ohioan and a graduate of Kent State University, he also had valuable experience in newspaper reporting and advertising agency work.

G. F. Jackson

P. A. Dempsey

Continuing in the work of the AMC Tax Committee, headed by Chairman **Lincoln Arnold,** will be maintained under the direction of **Brice O'Brien.** O'Brien and Sherfy have jointly made many important contributions in the field of mineral taxation during the past four years.

E. G. & F. A. to Build Second Large Preparation Plant This Year

Eastern Gas and Fuel Associates have announced plans to construct a new coal preparation plant at its two Kopperston mines in Kopperston, W. Va.

Designed by Eastern's coal preparation department for a 11,000-tpd capacity, the plant will incorporate dense medium washers, tables, froth flotation and thermal drying. Construction will start in August and will be completed in the spring of 1962. Roberts & Schaefer Co., Chicago, is the general contractor.

This is the second major preparation plant to be built by Eastern this year. A 12,500-tpd plant is now being erected at the company's Federal No. 1 mine at Grant Town, near Fairmont, W. Va. In addition, the cleaning plant at Eastern's Keystone mine in southern West Virginia is being enlarged.

Anthracite Drainage Project Approved

The Department of the Interior has approved a $165,000 anthracite mine-water-control project near Nanticoke, Pa.

The new project, latest in a series financed jointly by the Federal Government and the Commonwealth of Pennsylvania, is designed to improve the surface-drainage area overlying the Glen Alden Corporation's Wanamie mine. According to the Bureau of Mines, which recommended approval of the project, its completion will prevent an estimated 60 million gallons of water from entering underground workings of the Wanamie mine each year. This will be accomplished by filling eight nearby strip pits where rainwater now collects, by grading the surface to minimize erosion, and by reconditioning old ditches and digging new ones to divert water into Newport Creek.

The Commonwealth of Pennsylvania will advertise for bids on the work, which will be performed under supervision of the Pennsylvania Department of Mines and Minerals. Once completed, the project will be maintained by the mine operators.

Champion Copper Mine Reopened

Copper Range Co. has announced the reopening of the Champion Copper mine at Painesdale, Mich. White Pine Copper Co., which operates the mine, is a subsidiary of Copper Range.

Cement Companies To Ship by Barge

To put itself in a better position to meet foreign competition, Alpha Portland Cement Co. is planning to ship cement by barge from its Catskill, N. Y., plant to New England points for distribution in truck-load lots to local users. The company is in the last stages of arranging for a bulk-distribution plant at Bridgeport, Conn. The company is looking for locations in other cities too.

Lehigh Portland Cement Co. will also meet competition from imported cement by shipping cement by barge from its Hudson River plant to New Haven, Conn., and Providence, R. I. The company plans to build storage silos at the New England ports this fall. Actual start of barge-truck deliveries in New England will begin next spring. Shipping by barge, according to the company, should reduce the cost to consumers in those areas and thus allow the company to compete on a firmer base with low-priced foreign cement. The company also announced that its new plant at Mitchell, Ind., will be finished July 1.

Safety Campaign Paid Off

The 1960 Campaign to prevent Roof-Fall Injuries in Coal Mines resulted in the saving of 35 lives and the prevention of 228 disabling injuries, according to Clinton H. Hoch, staff representative for the National Safety Council's coal mining section.

Speaking at the 36th Annual Western Pennsylvania Safety Engineering Conference, he reported the results of the Council's second annual campaign to prevent injuries from roof falls. Final reports were submitted by 385 mines in the United States and Canada which participated in the campaign. Of these, 264 mines achieved the campaign goal of a 50 percent frequency-rate reduction in injuries or a year free of roof-fall injuries.

An over-all 25 percent reduction in injury frequency rates was shown.

NCA Holds Convention in Washington, D. C.

National Coal Association held its 44th Anniversary Convention on June 6–8 in Washington, D. C. Of particular interest was the session on June 7 at which spokesmen for major industries allied with coal discussed "Prospects for the Sixties." Speakers included Allen S. King, president, Northern States Power Co.; Stuart T. Saunders, president, Norfolk & Western Railway; Harold C. Lumb, vice president, Republic Steel Corp.; and W. L. Wearly, president, Joy Manufacturing Co. John M. Kelly, Assistant Secretary of the Interior for Mineral Resources, delivered the keynote address, and D. D. Wyatt, National Aeronautics and Space Administration spoke at that day's luncheon.

The three-day program also included an address by Chairman Oren Harris of the House Interstate and Foreign Commerce Committee who discussed the legislative outlook. George A. Lamb, director of the Office of Coal Research, discussed his agency's plans for the future.

Election of new officers took place on the final day of the meeting. George E. Enos, president of the Enos Coal Mining Co., was elected chairman of the NCA board of directors, succeeding Herbert E. Jones, chairman of the board of Amherst Coal Co. H. Vernon Fritchman, executive vice president of Rochester & Pittsburgh Coal Co., succeeds Enos as vice chairman. Stephen F. Dunn was reelected full-time president of NCA, and Thomas Howarth was elected secretary-treasurer. He had been secretary only.

Technical Mining Session Presented at Ohio State

Theme of the Technical Mining Session program presented by the Mining Engineering Division, the Ohio State University, was "Pioneering Mining Developments in Ohio." Held April 28, the mining program was part of the Annual Conference for Engineers, which attracted over 800 engineers to the college campus.

The program, presided over by J. Richard Lucas, professor, Mining Engineering Division, included S. G. Hughes, president, Differential Steel Car Co., who spoke on the coal industry's Old Timer's Club and made the annual watch award to the most outstanding mining engineering student. W. A. Weimer, chief mining engineer, Peabody Coal Co., substituting for his colleague, William Hartman, general superintendent of mines, discussed the operating and engineering problems of "Automatic Mining" at the Coshocton County coal properties in Ohio. Andrew Hyslop, chief engineer, Hanna Coal Co., presented a paper entitled, "Engineering and Operating Study of High Capacity Stripping Shovels."

ALSO . . .

The Ohio River Co. has announced a plan to supply California industries with West Virginia Coal. If the plan is approved, a half million tons of coal could be shipped annually to the West Coast from West Virginia by a transcontinental shipment plan utilizing railroad and barge lines. The coal would be hauled by Norfolk & Western Railway Co. lines to Renova, W. Va. It would then be transferred to a barge and carried to a Gulf Coast port and railroad terminus where it would complete the rest of the trip by rail.

Pittsburg & Midway Coal Mining Co. has purchased a 90-cu yd. shovel from Bucyrus-Erie Co. Scheduled for delivery next year, the Model 1850-B will weigh over 8,000,000 lb and stand more than 150 ft in the air. The machine's electric power plant. totaling 9000 hp, will enable it to dig out 150 tons of overburden, swing and deposit it more than 300 ft away in less than a minute's time.

National Lead Co. has started construction of a multi-million dollar research center near Highstown, N. J. The first unit of the center is scheduled for completion in mid-1962, and will be devoted to research and development in the fields of non-ferrous metals, paints and pigments, lead chemicals, plastics and resins. The staff of scientists and technicians at the company's Brooklyn research laboratory will be transferred to the new center when it is completed.

The Windrock Coal Co. mine near Oliver Springs, Tenn., closed June 24. Company officials said the mine can no longer pay the wage scale under a United Mine Workers contract and compete in price with coal coming from Kentucky and other Tennessee mines. Coal from the Windrock mine has largely been sold to TVA's Kingston steam plant.

Copper Products Development Association has authorized expenditures of $192,000 in five new research projects designed to develop new or improved uses for copper. Two of the five studies will be conducted by Battelle Memorial Institute. They pertain to the development of a tarnish-resistant copper by metallurgical surface treatment and the development of increased use for copper as an alloying element in cast iron. A study on the development of copper compounds as additives for gasoline was awarded to Quantum. Inc., while Dynatech Corp. will seek to develop a new form of copper that is thermally conductive but electrically insulating. The fifth project was awarded to Chase Brass & Copper Co., which will continue the evaluation of clear plastics for the protection of copper base alloys.

One of the largest self-unloading ore carriers in the aluminum industry, the ***S.S. J. Louis*** was recently launched at Kure, Japan, for Caribbean Steamship Co., S.A., a subsidiary of Reynolds Metals Co. Named for J. Louis Reynolds, chairman of Reynolds International, Inc., the $10,750,000 ship has a deadweight capacity of 32,490 long tons and will carry about 31,500 long tons of bauxite. The vessel will be used to haul aluminum ore between ports in Jamaica, Haiti, and Texas.

NEWS and views

Contract Let for Extinguishing Coal Fire

The Bureau of Mines has awarded a contract for controlling a coal bed fire that has burned nearly 25 years on public land near Paonia, Colo. The job was contracted to Earl Troop of Cory, Colo.

Troop will conduct exploratory drilling to determine the depth and thickness of the coal bed, and then cover the burning area in efforts to smother the blaze and prevent its spread. The fire covers an area of about an acre, having burned more than 300 ft along an outcrop since its discovery in 1937.

Coal reserves that will be saved from destruction are valued at many times the $6697 contracted to be spent on the project. In the past, Federal fire-control projects have cost about one cent per ton of coal saved. Between 1949 and 1960, the Bureau directed 80 sucessful coal-fire-control projects saving the Nation an estimated 306,000,000 tons of coal. There are presently 227 uncontrolled fires burning in inactive coal deposits in the United States.

Mines Bureau to Acquire Large Gamma-Ray Source for Minerals Research

Plans for building an atomic-research facility at Albany, Ore., for studying minerals and mineral fuels have been announced by the U. S. Bureau of Mines.

The new structure, scheduled for completion in the next 12 months at the Bureau's Metallurgy Research Center, will house 100,000 curies of cobalt-60, to be supplied by the Atomic Energy Commission. This radioactive isotope will be used in fundamental research to determine the effects of gamma radiation on the physical and chemical properties of coal, petroleum, and many metallic and non-metallic minerals, the Bureau said.

Scientists believe that gamma irradiation may help advance mineral technology, either by altering the properties of minerals and fuels so they can be processed more easily or by actually speeding chemical reactions in mineral-treating processes. Small-scale studies by the Bureau of Mines already have indicated that both approaches are promising.

Lead-Zinc Groups Hold Annual Meetings

American Zinc Institute held its 43rd Annual Meeting on May 1–2, and the Lead Industries Association held its 33rd Annual Meeting on May 2–3. A joint LIA-AZI session was held on May 2.

The zinc industry discussed new directions in zinc usage as well as progress achieved in recently initiated zinc research. Speakers described the contribution of galvanized steel to modern automotive design, the activities of the steel industry in promotion of galvanized sheet, and discussed zinc's important part in national highway programs. Also heard was a paper on the flexible role of the die casting engineer in modern product design, and a progress report on the AZI-LIA Expanded Research Program. Session chairmen were R. G. Kenly, president of American Zinc Institute and vice president of the New Jersey Zinc Co., and M. M. Zoller, president of the Chemicals & Metals Division, the Eagle-Picher Co.

LIA's meeting had the theme "New Frontiers" in lead markets and the program covered such topics as solid state physics, noise and vibration control and power sources. In the field of lead-acid storage batteries for motive power, three new applications were covered: electric street delivery trucks, personnel carriers, and electric passenger cars. The various sessions were under the chairmanship of Jean Vuillequez, LIA president and vice president of American Metal Climax, Inc.; Simon D. Strauss, LIA vice president and vice president of American Smelting & Refining Co.; and Charles R. Ince, LIA vice president and vice president of St. Joseph Lead Co.

Signs 25-Year Mine Lease

A 25-year lease has been signed by Bunker Hill Co. with Nancy Lee Mines, Inc. The agreement which carries a 25-year renewal clause and is subject to approval by Nancy Lee stockholders, covers 10 patented and 51 unpatented claims at Nancy Lee's promising lead, zinc, silver and copper mine near Superior, Mont. Operation of the mine and a 120-tpd mill will be taken over by Bunker Hill. The lease calls for deepening the Nancy Lee shaft by 400 ft and additional development drifting on the 790 level. It also provides for royalty payments to Nancy Lee on a sliding scale depending on ore grade. Development at the mine dates back about 25 years when several properties were consolidated to form the present company.

Aluminum Complex Planned

A $100-million integrated aluminum complex is to be built in Australia by Alcoa of Australia Proprietary Ltd., which will be owned 51 percent by Aluminum Co. of America and 49 percent by Australian mining companies. Construction will begin by the end of this year and operations are to commence within two years. The project includes bauxite mining and refining facilities in Western Australia near Perth, and a 40,000 ton per year smelter, fabricating and

power plants at Geelong, 1700 miles to the east. Alumina from the refinery will be transported to the proposed smelter by sea.

ALSO . . .

Sunshine Mining Co. has entered into an agreement with Humble Oil & Refining Co. providing for further exploration and development of Sunshine's oil and gas properties in Grays Harbor County, Wash. Humble will be the operator and Sunshine will share in the proceeds of production.

A 120-tph iron ore beneficiating plant has been put in operation by Utah Construction & Mining Co. at its Iron Springs, Utah, open pit mine. Construction of the plant was begun in August 1960. It utilizes crushing, and dry and wet magnetic separating equipment to make shipping grade, which must contain in excess of 50 percent iron. Mining of ores containing as low as 20 percent iron is said to be feasible with the new concentrator in operation.

Hidden Splendor Mining Co. is examining a copper and silver prospect in the Sunlight Basin, Park County, Wyo., under a lease from Skyline Corp. The property, which is located in the Absaroke Mountains, has not been worked since 1910.

Bear Creek Mining Co. is erecting a new headquarters building in Denver, Colo., which is expected to be one of the Nation's most completely equipped geophysical laboratories concerned with mineral exploration. Located at 1490 S. Lipan St., the 10,000-sq ft building is slated for completion in September.

Two hundred and sixty berryllium claims in the Spors-Topaz Mountain area of Utah have been acquired by General Beryllium Corp. The company has total holdings of about 5500 acres, constituting one of the largest claims in the area, and has begun surface and underground development to determine the extent of beryllium mineralization.

An option on the Red Top lead-zinc-silver mine near Leadpoint, Wash., has been taken by Rare Metals Corp. of America. The company plans to drive a 500-ft exploration drift 100 to 150 below the present adit. The objective would be to tap at depth a shoot of ore that was previously mined in 1958.

Beryllium metal has been successfully produced from ores obtained in the Topaz Mountain area of Utah. Brush Beryllium Co., at its Elmore, Ohio, refinery produced the metal in the form of pebbles. The company has been operating a pilot plant for treating Topaz ores for the past four months. Brush uses a process that involves a series of mechanical and chemical steps to separate out a semi-purified beryllium compound which is then purified to yield beryllium. The company's experience demonstrates that extraction of beryllium from Topaz ore is economically feasible.

Dawn Mining Co. has taken an option on a copper property on the Colville Indian Reservation near Nespelen, Wash., and plans to undertake diamond drilling and stripping.

Emerald Empire Mining Co. and the Office of Minerals Exploration have executed a contract providing for expenditures in the amount of $54,300. The company will use the funds in the exploration of a lead-zinc-copper deposit at the Musick mine in Lane County, Ore. Government participation in the project will be $27,150.

A "potash borer" has been installed by International Minerals & Chemical Corp. at its Carlsbad, N. M., potash mine. The machine, costing in excess of $300,000, will be used in a program aimed at finding a means for mining thin potash beds at the Carlsbad mine and determining the best mining method for controlling extreme pressures anticipated in mining deep Canadian potash.

ALSO . . .

Ralph M. Parsons Co., Los Angeles engineering and construction firm, has purchased Anaconda-Jurden Associates, Inc., engineering and industrial design subsidiary of the Anaconda Co. Parsons-Jurden Corp., as the newly acquired firm is to be called, will be operated as a subsidiary of Ralph M. Parsons Co. Wilbur Jurden, formerly president of Anaconda-Jurden, will be president of Parsons-Jurden which will continue to have offices at 26 Broadway, New York.

Cyprus Mines Corp. plans to increase processing capacity at its Bagdad, Ariz., milling operation from 240 dry short tons per day to 300-tpd by installation of a heavy-media separation plant. The plant will remove barren and low-grade material from ore before grinding.

One-hundred and eight wet-type magnetic separators will be installed at the Atlantic City, Wyo., taconite beneficiation plant of the Columbia-Geneva Division, U. S. Steel Corp., now under construction.

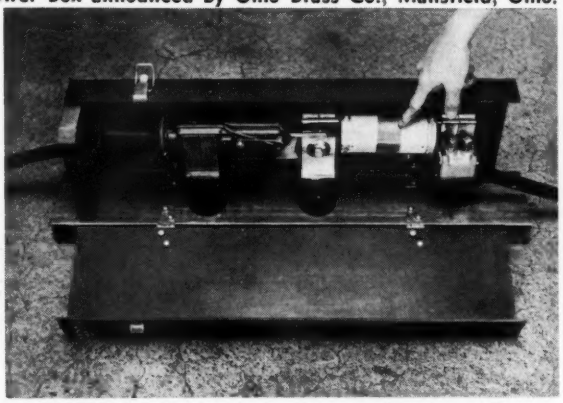
"Look at it THIS way, Al—loan me ten bucks and you can deduct it from income tax as a bad debt!"

The equipment will consist of 12 triple-drum rod mill cobbers, 36 single-drum ball mill roughers and 12 triple roll finishers. They will be of the electro type, which permit varying the intensity of the magnetic field to suit specific ore recovery or metallurgical requirements.

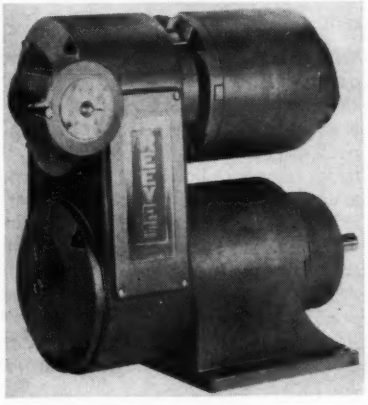
A 300-tpd concentrator will be built at Park City, Utah, according to plans of New Park Mining Co. The company proposes a mill using flotation and cyanidization for processing lead, zinc, silver, gold, and copper bearing ores from its Mayflower mine. New Park indicates that exploration at the mine revealed sufficient mineralization in the Pearl and Mayflower fissures to justify the mill. Construction is scheduled to begin this fall with completion slated for early 1962. The company's annual report for 1960 stated that there was a possibility of building an underground mill and using the tailings for stope fill.

manufacturers forum

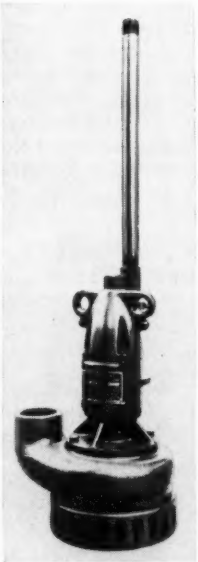
LOW COST 600-AMP FUSED PROTECTION is offered in a new device called the Fused Power Box announced by Ohio Brass Co., Mansfield, Ohio. The product is offered in two types—one for easy-carrying from job to job and the other for wall-mounting with a built-in switch for cutting the circuit during fuse changes (which is accomplished by detaching the Power Box from power source during the fuse-change). Both types are designed for heavy duty mining applications. The two types are alike in construction, sharing all major components, with many of the parts being interchangeable. Working parts are enclosed in a compact glass-fibre case.



A MOTORIZED VARIABLE SPEED DRIVE, the Reeves Motodrive, is now available for 25 through 40-hp ratings from Reeves Pulley Div., Reliance Electric Engineering Co., 27401 Euclid Ave., Cleveland 17, Ohio. It is complete, with single, double or triple stage gearing, and provides speed ratios up to 4:1 and output speeds from 2630 rpm to 25 rpm. The size 600 Motodrive is available, vertical, horizontal and 45° models for wall or ceiling mountings. Either "C" flow or "Z" flow output shaft arrangement is standard for all assemblies. "Scoop" mountings to meet J. I. C. standards and NEMA "D" output flange mountings are also available.



A SELF-CONTAINED PORTABLE PNEUMATIC SUMP PUMP has been announced by Schramm, Inc., 900 East Virginia Ave., West Chester, Pa. It has wide application in the removal of sludge, chemicals, oil or other residue from mines, quarries and other excavations. The pump body, impeller, and strainer are made of bronze to resist corrosion and to insure spark-free operation. The two-part, non-clogging impeller is mounted on a stainless steel shaft and supported by heavy duty thrust and radial bearings. The pump requires no priming and is ready for instant use; it is 19⅜ in. high, can be passed through a hole as small as 10 by 12 in.; and has speeds varying between 3200 and 3600 rpm.

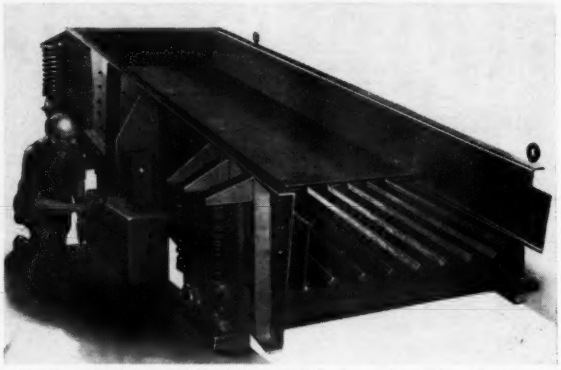


A HEAVY-DUTY, EQUAL PRESSURE OXY-ACETYLENE WELDING TORCH, the 63-F, is now available off-the-shelf according to its manufacturer, The Harris Calorific Co., 5501 Cass Ave., Cleveland 2, Ohio. The new torch features high-temperature silicone "O" ring seals that permit fast, easy change of tip assemblies. The torch's universal-type mixer accommodates the first 12 Harris tip sizes. The other sizes (15, 19 and 22) have individual mixers for maximum safety. Harris S-43-4 multi-flame heating assembly also may be used with the new torch as well as a cutting attachment that cuts up to 6 in. The 63-F has a handle diameter of 1⅛ in., a practical size for the heavy-gloved hand.

The QUICK DISCONNECT BRUSH TERMINAL ASSEMBLY made by National Carbon Co., 270 Park Ave., New York 17, N. Y. for installation on motors or generators with a 90° bend has been varied to provide a straight clip to the company's line. One of the major advantages of the assembly is that two spade terminals can be inserted in one clip, eliminating the need for extra clips in many installations. To minimize electrical resistance, clips are made of silver-plated beryllium copper, and the spade terminals of silver-plated copper. They are capable of carrying a continuous current of 150 amp, and are designed to facilitate brush replacement on both industrial and utility equipment.

BATTERIES WITH AN ELECTRICAL CAPACITY OF 85 AMPERE HOURS per positive plate have been added to the Exide-Ironclad line. The new TSC Ironclads are designed for use in many types of counterbalanced and stand-up, center-control and end-control fork lift rider-type trucks and pallet-type and fork lift hand trucks. The batteries are available in eleven standard sizes—with from 11 to 33 plates per cell—in capacities ranging from 425 to 1360 AH. All capacity ratings or TSC Exide-Ironclad batteries are based on full initial capacity with 1.275 to 1.285 specific-gravity electrolyte.

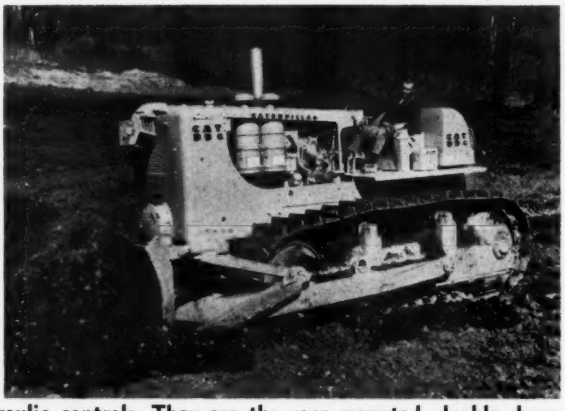
LOW HEAD HEAVY DUTY VIBRATING FEEDERS for controlled conveying and feeding of coal, ores and aggregates from truck dump hoppers or any location requiring uniform material feeding is being introduced as a standard line by Allis-Chalmers Mfg. Co. Available at 5 and 10° slopes with solid pan deck or partial pan in combination with a grizzly section at the discharge end, the new feeders can be obtained in 3, 4, 5 and 6-ft widths and 12, 14 or 16-ft lengths. They have replaceable pans and sideplate liners and can accommodate large feed. Bracket type floor mountings have steel coil springs and friction checks for maximum vibration isolation. The feeder can be supplied with either a standard, high torque or a variable speed, wound rotor motor with pivoted base when variable feed rates are desired. The combination pan and grizzly feeder is particularly suited for removal of fines ahead of crushers or for scalping.



AUTOMATIC UNLOADING OF COAL BARGES is possible with a new system whose basic component is the rotary bucket wheel which has been designed by McDowell-Wellman Companies, Cleveland, Ohio. The typical M-W plant rated at 3000 tph, could handle 10,800,000 tons a year at a cost of three cents a ton, the company estimates. The unloading apparatus is supported by four structural steel towers which support an elevating bridge spanning the barge berth. A trolley within this bridge carries the bucket wheel unit and the lower end of the collecting conveyor; the upper end is mounted on a traveling pivot and connects with the landward conveyor system.

Barges to be unloaded are brought alongside the dock and attached to an automatic barge hauling system. The wheel goes into operation as the first barge is advanced under the bridge. The wheel digs across the width of the barge as it moves forward. When the top layer of coal is unloaded, the barge is drawn back and the bottom layer removed. Buckets on the wheel discharge onto transverse roller feeders which deliver it to the belt conveyor system.

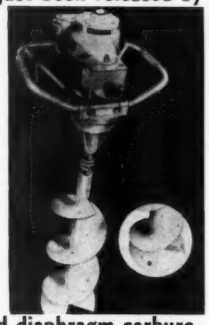
THE NEW TRACTOR SERIES, Cat D9G, combines a 15 percent horsepower increase with basic improvements to power shift transmission to boost production capability according to its manufacturer, Caterpillar Tractor Co., Peoria, Ill. Overall versatility and adaptability in a wide range of jobs is improved by the introduction of three entirely new hydraulically boosted cable controls, and arrangements of three different hydraulic controls. They are the rear-mounted, double drum 129 cable control for scraper operation; the single drum, rear-mounted 129 for bulldozer work and the front-mounted, single drum 119, also for the bulldozer.



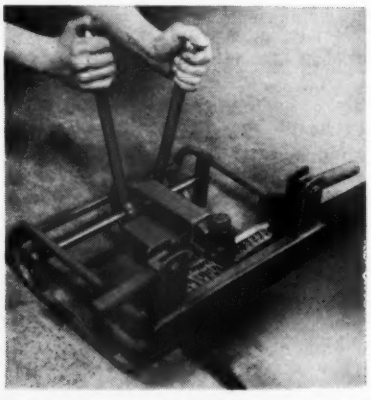
The higher horsepower, it is now 385 flywheel rating, results from a system of controlled turbocharging with aftercooling of intake air and provides maximum air flow over a wide range of engine operations.

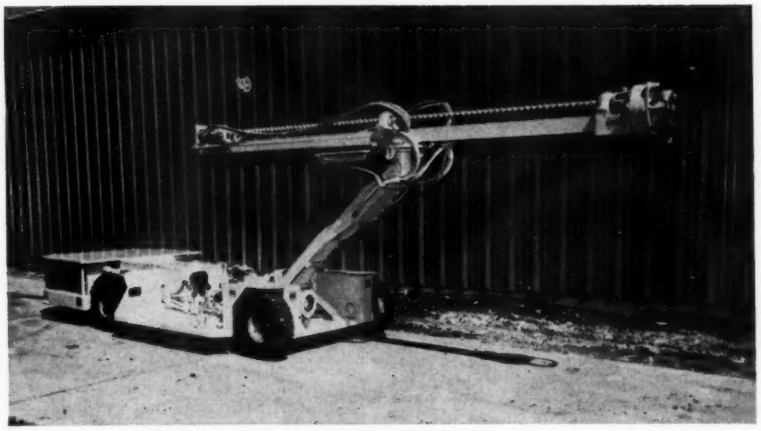
LIGHT WEIGHT PLANETARY WINCHES designed especially for applications where weight and/or space are primary considerations have been announced by Pacific Car and Foundry Co., Renton, Wash. They are available in four models, known as the "P" series, and range in capacity from 10,000 to 90,000 lb. They will accommodate mechanical, electrical or hydraulic drives.

A PORTABLE AUGER-DRILL, the No. 26100, has just been released by General Metals Corp., Watertown, Wis. It can be used in augering and drilling in soil, masonry, concrete and wood. The drill is powered by a 2½-hp, two cycle engine, with recoil starter and diaphragm carburetor. Replaceable cutting lips made of rock drilling martempered alloy steel offer a highly flexible construction tool.



A PORTABLE ONE-MAN SPLICE MAKER for conveyor belts, The Hayden Zipper, is adaptable to all belt thicknesses, widths and types, and according to its manufacturer, National Mine Service Co., 2530 Koppers Bldg., Pittsburgh 19, Pa., can be used in coal seams as thin as 20 in. It has a transport height of 9¼ in., and a vertical working height with operating levers extended of only 16 in. One man can make conveyor belt splices with the Zipper in a single pass. Two spring-loaded clamps, applied by cam action, hold the belt firmly in position for splicing, each clamp providing a holding pressure of 400 lb.





A 15-HP MOBILE COAL DRILL has been designed by Long-Airdox Co., Oak Hill, W. Va., for drilling at heights from 21 in. to 72 in. The Model TDF-15A machine incorporates the company's new "Rotary Thrust" drill head which applies thrust to within a foot of the coal face. The machine has the ability to drill holes parallel to the roof, and only 2½ in. from it.

Hydraulic power, developed by a 15-hp a-c or d-c motor, operates all functions, including 2-wheel drive tram at 0 to 150 fpm, 2-wheel steer, boom lift, drill beam swing and tilt, drilling and retraction at 0-33 and 0-150 fpm respectively, and 500-ft. cable reel. The TDF-15A is 19½ ft. long with 13 ft. augers. Chassis length is 11 ft. 4 in., width 66 in., and ground clearance 5¾ in. Weight is 5000 lb.

CATALOGS & BULLETINS

BELT CONVEYOR COMPUTATIONS. *Goodman Mfg. Co., Halsted St., and 48th Pl., Chicago 9, Ill.* Complete with tables, formulas and charts this booklet covers motor and belting requirements in line with standards adopted by the Mining Belt Conveyor Section of the National Electrical Manufacturers Association. The foreword mentions that the scope of the book, however, does not include computations of high belt tension conveyors, or those of unusual applications. The purpose of the book is to furnish the men responsible for a mine's conveyor haulage system with information useful in meeting commonly encountered problems of horsepower and belting requirements.

ROTARY VIBRATORS. *Syntron Co., 703 Lexington Ave., Homer City, Pa.* Complete data and specifications of the company's line of electro-mechanical rotary Vibrators is available in Bulletin RV-32061. The vibrators are totally enclosed, dust and water-tight and are lubricated through easily accessible fittings.

TRACKSIDE SHAKEOUT. *Department TC, Hewitt-Robins, Stamford, Conn.* The company's new equipment in trackside car shakeouts is described in Bulletin 172. Complete pushbutton control makes the shakeout a one-man job. Equipment can be operated automatically from remote control station, and there is no heavy, suspended equipment needing manhandling into position. Specifications of the equipment are: Weighs 2400 lb., has 7½ hp high torque vibrator drive and 3 hp hydraulic pump motor.

ROTARY FEEDERS. *Beaumont Birch Co., 1505 Race St., Philadelphia 2, Pa.* This bulletin describes the Beaumont S. T. T. Type Rotary Feeder which has adjustable periphery seals and adjustable and renewable tips on the rotor blades that permit working pressures up to 25 psi. Illustrations and diagrams show how every part of the feeder subject to wear can be adjusted from the outside without removing the feeder from duty. Other design features and options are described in this well illustrated bulletin.

MOBILE COMMUNICATIONS. *General Electric Communication Products Dept., P. O. Box 4197, Lynchburg, Va.* "Complete Control with Two-Way Radio" (Bulletin ECR-793) describes how mobile communications integrates operations of any business where vehicles are used for sales, service, delivery or supplies. All of a company's vehicles can be put on a single system set up on separate networks in line with the company's needs.

COMPRESSOR VALVES. *Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.* A 44-page booklet, Form 3222, entitled "Questions and Answers about Valving," details the demands made on valves and their function in a compressor, and traces the evolution of valving from the mechanically-operated intake valves and heavy poppet discharge valves of the 19th century to modern, high-speed air-cushioned valves. There is a section about the procedures and equipment used in the manufacture of modern valves, and an assembly line which transforms raw material stock into finished valves is described and pictured. The catalog is amply illustrated.

(Continued on next page)

—ANNOUNCEMENTS—

Chicago Pneumatic Tool Co., New York, has announced a number of executive elections headed by the naming of **Guy J. Coffey** as chairman of the board and chief executive officer of the company. In these

G. J. Coffey

N. Readman

posts he succeeds H. Arnold Jackson who will continue as a director and chairman of the executive committee. Coffey has been succeeded as president by **Norman Readman,** formerly managing director of the company's overseas operations. Other elections were those of **Thomas F. Noonan** as vice president and comptroller and **Carra L. Lane** as vice president and manager of plant operations.

L. J. Burger

Lewis J. Burger, has been named president of **Letourneau - Westinghouse Co.,** Peoria, Ill., succeeding **Merle R. Yontz,** who has accepted a position at **Caterpillar Tractor Co.** Burger comes to his new post after years in management positions with General Electric.

Frank J. Durzo, vice president in charge of manufacturing for **Jeffrey Mfg. Co.,** Columbus, Ohio, has been

C. J. Leifeld

F. J. Durzo

named executive vice president. He succeeds **C. J. Leifeld** who has retired after a 45 year career with the company. Durzo has been with Jeffrey since 1947.

(continued from previous page)

DRILL RIGS AND TOOLS. *Mobile Drilling, Inc., 960 N. Pennsylvania St., Indianapolis 4, Ind.* Covering Mobile's complete line of hydraulic powered drill rigs, tools and accessories, 80-page Catalog No. 615 is fully illustrated and gives detailed descriptions, with cross-indexes for fast reference on over 1900 items related to rotary drilling.

BRONZE VALVES. *Ohio Brass Co., Mansfield, Ohio.* O-B Publication No. 1496-V contains condensed listings of standard and low pressure Gate, Globe and Angle, Check, and special valves, figure number comparison chart, application and installation tips, and other pertinent information about the complete line of Ohio Brass bronze valves.

CONTINUOUS BORER. *Goodman Mfg. Co., Halsted St. and 48th Place, Chicago 9, Ill.* G-151 details the Goodman 428 (a-c or d-c) Continuous Borer described as "a single pass machine for full face continuous mining at any height between 6 ft and 7½ ft." The machine is reported to be suited to any phase of development work, room driving or pillar recovery, and its advantages are listed as a variable mining height, high productive capacity, practical mobility and uniform full power from two, 250-hp mine duty motors.

METAL CLEANING AND PROCESSING. *Turco Products, Inc.* This illustrated, 12-page metalfinishing brochure entitled "Specialized Chemical Processing Compounds for the Metalworking Industry" contains specific information for the use of each of the 43 products comprising Turco's standard line of cleaning and processing compounds. Some of the processes described are: cleaning, phosphating, conversion coatings, protective coatings, paint and carbon removing, descaling, rust removing and prevention, inspection, processing aluminum.

SINGLE ROLL CRUSHER. *McLanahan Corp., Hollidaysburg, Pa.* Bulletin SBD-95 describes the McLanahan Super Black Diamond Crusher, a single-roll unit designed to crush gypsum, phosphate, rock, shale, mine refuse and ores. It is described via construction data, sizes, crushing capacities, and dimension drawing.

ELECTRIC WINCH-HOIST. *City Engineering Co., Inc., 3547 Massachusetts Ave., Indianapolis 18, Ind.* Uses included in Bulletin M-61 of the My-te electric winch hoist are in a wide variety of truck loading and pulling operations, and in drilling. The unit can lift 2500 lb and pull 5000 lb with double line. It weighs only 60 lb, is portable, and mounts with six bolts on truck, car or boat. The battery-powered model works off any 6 or 12-v battery, while the 110-v a-c model operates from portable generator or other available power source.

CORE DRILL MACHINE. *Sprague & Henwood, Inc., Scranton 2, Pa.* The 142-C core drill machine described in S&H's Bulletin 170 is used in deep-hole and large diameter diamond core drilling, and has capacities ranging from 2250 ft for EX drilling to 500 ft with 6 in. and 7¾ in. core barrels. Drill features are: a heavy duty gear box and front bracket assembly; industrial type overcenter clutch; all-steel castings; alloy steels at critical points. The 142-C can be skid, truck or trailer mounted.

WOOD PROTECTION. *Wolman Preservative Dept., Koppers Co., Inc., 750M Koppers Bldg., Pittsburgh 19, Pa.* "Wolmanized Pressure-Treated Mine Ties, Timbers and Lumber" is an illustrated eight-page brochure on wood protected against deterioration from rot-producing fungi. Used for above-ground and below-ground applications, Wolmanized timbers reportedly provides safer, less hazardous mine operation, improved production, and reduced maintenance and operating costs.

TUBE FITTINGS. *The Lenz Company, Dayton 1, Ohio.* The company has just published a reference circular of applications, and other data dealing with their patented "O-Ring Seal with Separate Split-Ring Grip" tube fittings. The features and advantages of the fittings, instruction for their use are covered in detail with drawings of their assembly and application.

TRACK MAINTENANCE JACK. *Duff-Norton Co., Four Gateway Center, Pittsburgh 22, Pa.* Advantages of a new, compact, 15-ton capacity aluminum track maintenance jack are detailed in an illustrated reference sheet, Bulletin AD-115, available from Duff Norton. The catalog contains specifications and applications for nine single-acting and double-acting D-N track maintenance jacks. There is a section covering interchangeability of parts for all track jacks.

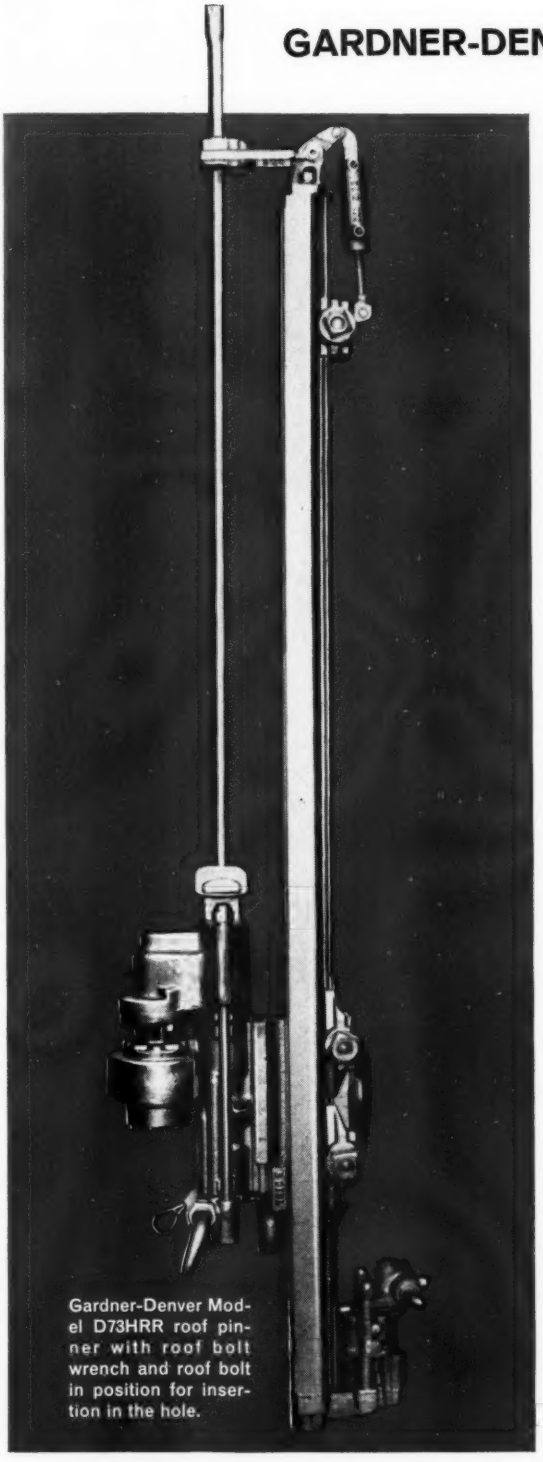
COAL HANDLING. *Advertising Div., Caterpillar Tractor Co., Peoria, Ill.* Form D108 entitled "Geometry of Coal Handling" poses a number of coal handling problems and uses actual job studies to suggest solutions for them. Two examples are given of power companies requiring short distance hauls to reclaim coal from storage. A second problem concerns the needs of a small utility plant requiring 100 tons of coal in an hour's loading. A third job story covers a power plant requiring a 500 to 1500-ft haul and high coal production.

BELT CONVEYOR ROLLS. *Webster Mfg., Inc., Tiffin, Ohio.* Webster's Series 156 line of medium-duty ball-bearing belt conveyor rolls are announced and detailed in Bulletin 456-10. Both troughing and return idlers are described in the bulletin, which lists dimensions and weights for 4 and 5-in. trough and return idlers for belts ranging from 18 to 36 in. in width.

PLANT LAYOUT PLANNING. *Allis-Chalmers, Milwaukee 1, Wis.* Allis-Chalmers sales representatives have available 9 by 11¾ in. portfolios of crusher and screen plant layouts. The layouts cover first, second and third stage crushing operations with screen arrangements. The folder also carries selection guides for determining proper types and sizes of crushers and vibrating screens along with illustrations and a description of the equipment. Drawings are scaled for use as templates.

Index to Advertisers

GARDNER-DENVER MAKES THE NEWS



Gardner-Denver Model D73HRR roof pinner with roof bolt wrench and roof bolt in position for insertion in the hole.

New roof pinner does all 3

1 DRILLS THE HOLE
2 INSERTS THE BOLT
3 TIGHTENS THE NUT

This Gardner-Denver roof pinner does the complete roof bolting job. It's Model D73HRR—your easiest step to simpler, quicker roof pinning.

Ask your Gardner-Denver Mining Specialist for a demonstration. See how the D73HRR remote-control pneumatic centralizer spots hole quickly, keeps the steel in line with the drill. Check all the features:

Powerful, trouble-free hydraulic motor —provides the required rotation speed for drilling in different types of rock.

Remote-control operation —of all functions of the drill, rotation motor, feed motor and centralizer.

Adjustable feed mounting —gives proper thrust when drilling, maximum speed when retracting steel or inserting bolt.

Pneumatic centralizer remote-controlled —provides excellent support for accurate hole spotting.

Protective roof bolt wrench —guards against hammer impact on the roof bolt if hammer is accidentally turned on during the nut-running cycle.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

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NEW Completely Transistorized M-S-A® Model E-60 MinePhone®

Here's the first mine communications system fully protected against power failure

Power failures can't knock out the rugged M-S-A E-60 MinePhone.

Always operative, power comes from the storage battery, on constant charge from the trolley. Takes only *one watt* of battery energy to ready the MinePhone for standby transmission or reception. In event of power failure, you still have hours of service from the fully charged battery. As power is restored, battery is automatically recharged.

The compact transistor makes possible a 35% reduction in size of this new transmitter/receiver. There are no vacuum tubes to wear out. No damage due to vibrations.

Consider these safety factors: the E-60 MinePhone — needing no warm-up period — permits instant reporting of hazardous mine conditions. Scheduling is more efficient. And in case of emergency you can alert both surface and mine personnel — keep them tuned in — even when trolley power is off.

You can realize an impressive pick-up of movements from face to tipple, too. More trips per shift without costly traffic tie-ups. Improved control and distribution of mobile equipment. No unnecessary starting and stopping.

Your MSA representative would be pleased to discuss your actual communication requirements. Call him soon. And write us for free product data bulletin. Mine Safety Appliances Company, Pittsburgh 8, Pa. In Canada: Mine Safety Appliances Co. of Canada, Ltd., 500 MacPherson Ave., Toronto 4, Ontario.

MSA